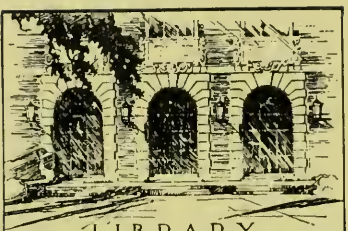


LIBRARY
OF THE
UNIVERSITY
OF ILLINOIS

505
MAY
v.1^{3}-3

SEP 23 1954

BIOLOGY

Digitized by the Internet Archive
in 2010 with funding from
University of Illinois Urbana-Champaign

http://www.archive.org/details/contributionstos13flor

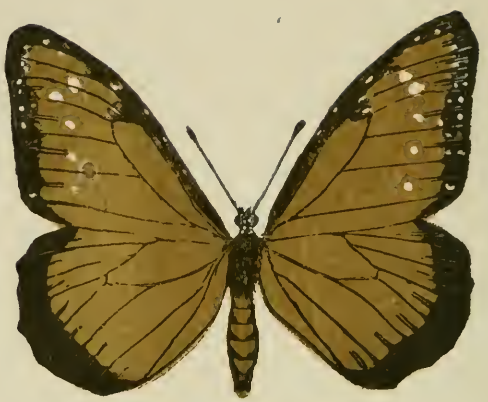
CONTRIBUTIONS TO SCIENCE

BY
CHARLES J. MAYNARD.

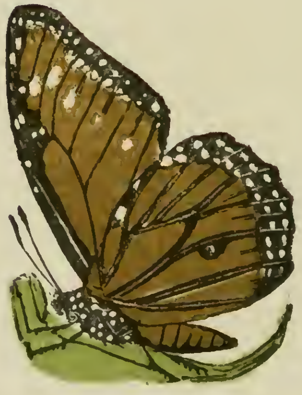
VOLUME I. 1889.

NEWTONVILLE, MASS.:
PUBLISHED BY THE AUTHOR.

PLATE X



2



1

Biol
505
M4y
v.1 3-3

EXPLANATION OF FIGURES ON PLATE X.

Danais berenice, Maroon Butterfly: Fig. 1, male, lower side: Fig. 2, female, upper side: both taken in Orange County, Florida, in October.

CONTRIBUTIONS TO SCIENCE.

BY

CHARLES J. MAYNARD.

Vol. I. October, 1889. No. 3.

THE SOUND PRODUCING ORGANS OF BIRDS.

In the following series of papers, I purpose giving some account of the various organs in birds that produce sound, illustrated with drawings made from specimens that have come under my observation.

AMPELIS GARRULUS.

Bohemian Waxwing.

During the winter of 1880 I received some fifty specimens of this species, in the flesh, from Mexico, N. Y., and Clayton, Minn., and was thus afforded an excellent opportunity of examining the vocal and other organs.

As I knew it to be a mooted point among ornithologists as to whether the Bohemian Waxwing is capable of uttering anything like song, it was with considerable interest that I examined the inferior larynx.

The sterno trachealis is present, but it is not only reduced to a mere transparent thread, but has no sternal attachment. This muscle has its tracheal origin, as in all of the true singing birds that I have examined, below the division of the broncho trachealis which muscle is present and well developed, from thence the sterno trachealis proceeds upwards, at a slight angle backward, and becomes firmly attached to the muscles of the neck.

This arrangement can be seen at Fig. 16; t being the trachea, b the broncho trachealis, m the lungs from which emerge the bronchial tubes, e e represents a portion of the neck to which the short sterno tracheal muscle adheres, n being the right and u the left of these. Both of these Figs., 16 and 17 are life size. Although it is not unusual for the lower larynx to receive support from filamentous tissues which are attached to the neck, this is the only case that has come to my knowledge where the sterno trachealis is so attached.

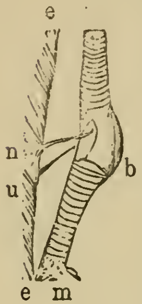


FIG. 16.

Owing to its point of attachment, this muscle must be quite functionless so far as being an aid toward producing sound, thus we are not surprised upon examining the bronchial tubes to find that there is no tympaniform membrane. The bronchial rings, although extending around the tubes, are not entire but there is a narrow division on the inside in th eplace usually occupied by the tympaniforms. I also find that the bronchials are connected firmly together by a thick membrane that adheres by a close attachment to the outer walls of the œsophagus. See Fig. 17, t, trachea; b. broncho tracheal muscles; o, œsophagus; m m, bronchial tubes with the connecting membrane between, while the dark lines above it represent the division where the tympaniforms should be.

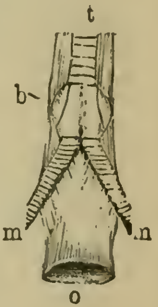


FIG. 17.

A careful examination shows that the os transversale, a thin bone that extends across the trachea between the openings of the bronchials, is present, and that it usually supports a semiluna membrane, but I have found several individuals of both sexes in which this is absent, and in no case is it well developed. The tympaniforms being absent, we must then look to this partly developed membrane, for all the sounds that this species is capable of uttering, and as it is absent in some specimens, we must conclude that if the Bohemian Waxwing sings at all, it sings as individuals, not as a species.

Here then, is a bird in which the power of song is being developed or is being lost, for analogy teaches us that organs having functions so important do not long remain in a half developed condition. In order to throw some light upon this point, we naturally turn to another species in the genus, the Cedar Waxwing, A. cedrorum, and examine its trachea.

Here we find that the sterno trachealis is present, and as in the garrulus, reduced to a mere transparent thread, but with the sternal attachment normal. The broncho trachealis is well developed: see Fig. 18, t, being the trachea; c. shows the origin of the sterno trachealis, n; b, the bronchial muscle; and m, the bronchial tubes. The semiluna membrane is not well developed and the tympaniforms are so small as to be nearly functionless. Whether, as in the Bohemian, there is individual variation in the development of the semiluna membrane I cannot now state, as I have had no recent opportunity of examining any very large series. I should expect to find such a variation, however, as it is highly probable that the Cedar Bird varies individually in regard to vocal powers; that is, like the Bohemian Waxwing, some individuals probably sing very well, while the great majority do not utter a note, save the lisping hiss so well known, and which could be produced by the os transversale alone.

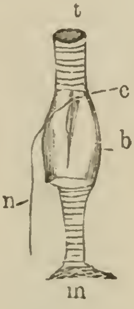


Fig. 18.

The knowledge that we have derived from the fact that the Cedar Waxwing, in possessing a better developed vocal apparatus than the Bohemian, gives a little aid in determining whether the two species are advancing or retrograding in power of emitting song. Judging from the more southern habitat of the Cedar Waxwing, which is nearest the center of greatest distribution of members of the family, the Bohemian Waxwing has become evolved from it, and as this has the vocal organs less well developed, we must conclude that the apparatus for producing sound is disappearing. An examination of the extreme young of either species would definitely settle this question, for if in this stage, the organs were better developed than in the adults, we must, judging from analogous cases, conclude that these Waxwings are degraded song birds. On the other hand, if the young show less development of these organs, then we must consider that their immediate progenitors are non singing birds, and consequently, that the Waxwings are being elevated in the avian scale into song birds.

PHILOHELA MINOR.

American Woodcock.

For years there has been a controversity among sportsmen and ornithologists, as to whether the whistling notes of the Woodcock, made when rising, are vocal or are produced by the peculiarly attenuated first primaries or in some other manner with the wings, as whether this sound is vocal. Much evidence is given in support of both views, but although I have nothing new to offer on either side, yet I may say, after carefully reading the testimony given on the subject, that I am inclined to think the preponderance of evidence is in favor of the sound being produced with the wings.

I shall, however, add in the following article, a grain of evidence in favor of the vocal notes, as I can prove most conclusively that the notes can be produced by the laryngeal muscles and membranes.

The main object of this paper, is to illustrate how the fine warbling notes given during the breeding season, so admirably described by Messrs. Nuttall, Brewster, Torrey, and others, are produced.

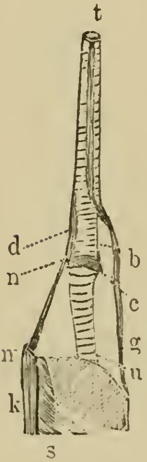


FIG. 18.

The trachea, or windpipe, of this bird is considerably flattened and widened at the superior, or upper, larynx, becomes narrower and rounder as it descends, then once more widens as it approaches the lower larynx, and here it is also flattened.

The lower larynx is peculiar; the sterno trachealis is present, and is well developed and there are tympaniform membranes that extend the entire length of the bronchial tubes. There is no os transversale and consequently no semiluna membrane. Thus at first sight, it would seem that all of the notes that this species is capable of uttering must be caused by the vibrations of the tympaniforms. This was the view of the case that I took in an account of the structure of the larynx of the Woodcock, published in the first edition of my Birds of Eastern North America, in 1881. In there making the statement that all of the notes given by the Woodcock are produced by the tympaniforms, I overlooked an important factor which I have since found plays a prominent part in the vocal apparatus of these birds. This is a small vibrating membrane that lies on the sides of the larynx, between the half rings of the bronchial tubes and the lower bones of the larynx. See Fig. 18, where a life size, side view, of the apparatus is given; t, trachea; u, a portion of the bronchial tube, and the shaded portion between c and n is the laryngeal vibrating surface. This surface is rendered tense or is loosened by the action of two pairs of strap like muscles. One, the remnants of the broncho trachealis ib. b, is not well developed extending to the upper half ring only, the other, the bronchialis, ib. d, is better developed, and exercises control over three half rings. These two pairs of muscles slightly oscillate the thin bones of the upper portion of the bronchial tubes, and thus tighten or loosen the laryngeal vibrating membrane to the minute degree necessary to cause it to produce a portion of the melodious notes given by the Woodcock. I say a portion of the sounds, for after all, the tympaniforms perform their share of the labor of vocalization.

Of course the principal relaxors for the tympaniforms are the well developed sterno trachealis, Fig. 18 g, but these membranes are rendered tense, to some degree, by the actions of the muscles ib. b and d which thus perform a double part. The tympaniforms, however, have another contractor in the form of a membranous muscle that extends from the larynx to the manubrium of the sternum, and spreading downward and backwards, adheres to the bronchials near the junction of the tympaniforms; ib. n is the laryngeal origin of this muscle, and m its termination on the manubrium: k being a portion of the keel, s a portion of the sternum. Only a part of this sternal laryngeal muscle is represented, the thicker, for it sends backward a thinner section that occupies the triangular space indicated between u m n.

Fig. 19 gives another view of the larynx, seen from below: t, trachea: t d d, the bronchialis muscle: m d d, the lower portion of the membrane which extends upward and backward to the bronchial tubes which are not represented.

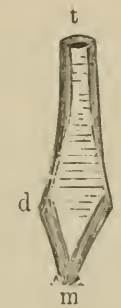


FIG. 19.

I should say that the harsh note of the Woodcock given when on the ground is produced by the vibration of the entire broad surface of the tympaniforms, whereas the more melodious warbling of the nuptial song, and possibly also the whistling twitter of flight, are from the laryngeal membrane, and from portions of the tympaniforms that are tensified partly by the muscles b and d, Fig. 18, and partly by the membranuos sternal laryngeal muscle, ib. n m, and Fig. 19, m d d.

Mr. Brewster says that the notes of the male Woodcock made in the spring "are sweet and musical, recalling the sound produced by a water whistle such as boys sell in the streets of our cities." ("Forest and Stream," Aug. 1st, 1889.) Now as this most clearly indicates that the sounds are liquid in their character, or in other words that there is nothing of the stridulous shrillness in them so noticeable in many species of birds that possess a well developed semiluna membrane, goes far toward proving the theory, that I have advanced, that the shrill notes of birds are produced wholly by the semiluna membrane, aided by the laryngeal muscles.

As supplementary to Mr. Brewster's idea, which is given in a most interesting article on the Woodcock in a recent number of the "Forest and Stream," quoted on the preceding page, that the whistle of the Woodcock when on the wing is used as a call to indicate its whereabouts to its mate and fellows, with which idea I quite agree, I would also suggest that a modification of this note is also used as an alarm. Thus when a Woodcock is suddenly disturbed, the whistling is given with considerably more vehemence than when it rises without being forced to do so, and this more rapid whistling must instantly inform every Woodcock within hearing that one of their number has encountered an enemy of some description.

(CONTINUED.)

NOTES ON THE HABITS OF SOME OF THE WEST INDIAN REPTILES AND BATRACHIANS.

The following notes on the habits of some of the West Indian reptiles and batrachians, were taken during two trips that I made to these islands, one in 1884 and again in 1887–88. I remained on the islands altogether a little over fourteen months, visiting, during this time, and exploring to a greater or less extent, New Providence, Andros, Green Key, Seal Key, the Washerwoman Keys, the Ship Channel Keys, Rum Key, Long Island, and Inauga of the Bahamas, and Jamaica, Little Cayman, and Cayman Brac of the other West Indies.

A greater portion of the collection of this class that I made, passed through the hands of Prof. Samuel Garman of Cambridge, and to him I am indebted for the Latin names; I am, however, responsible for the common appellations, these being those used by the natives, or such as I have deemed appropriate, they having been suggested in various ways.

ARISTELLIGER PRÆSIGNIS Hallow.

Wood Slave.

These peculiar lizzards are common in all of the buildings on the island of Cayman Brac. They are nocturnal in habit, or partly so, and are found during the daytime in dark corners, under the palm leaf thatch with which most of the houses are covered, or in crevices between the

the boards. I do not ever remember having seen this species on the ground nor upon any other than wooden structures, for which they exhibit so decided a preference as to have received the name of Wood Slave from the inhabitants. This is not an elegantly formed lizard, having a short, rounded nose, short legs, and a moderately short tail, thus in general appearance, reminds one of a salamander and the resemblance is heightened by the fine scaling.

The Wood Slaves are quite variable in coloration, but are usually chocolate brown, mixed with olivaceous, and mottled with darker on the head and body. The legs and tail are almost always transversely banded with dark brown. The iris is silvery, finely dotted with blue. Like all members of this group of lizards, the pupil of the eye is elongated transversely, giving the face a peculiar appearance. Specimens vary with age from two inches to seven or eight in length.

The Wood Slaves are sluggish in habit, yet at night climb about walls of the houses with ease. In all probability they subsist upon insects, but are apparently fond of sugar, as on several occasions I have found specimens eating it.

The skin of the body is very delicate, breaking quite easily, and I have even known it to peel off when I caught the animal. When first captured they exude a kind of moisture from the skin that has an odor similar to that emitted by our striped snake. This species is not confined to the island of Cayman Brac, but also occurs on Grand Cayman, Jamaica, and others of the West Indies, but I did not find it on Little Cayman, only seven miles from Cayman Brac.

SPHÆRODACTYLUS ASPER GARMAN.

ROUGH-SKINNED GLOBEFINGER.

The two specimens of this small lizard upon which Prof. Garman has based this species were procured at Middle Bight, Andros, Dec. 19th, 1887. I found them beneath the thatch of a fallen roof of a ruined hut, near the water and on the borders of an old field. Ants were very abundant beneath the palm fronds of which the thatch was composed and the lizards appeared to be living among them. Both of the little reptiles were lying close together, and when surprised by the removal of the frond instantly concealed themselves beneath another. They are a little over two inches in length; brown, with the scales minutely punctured with darker. The head is yellow, unmarked. Iris, bright yellow.

SPHÆRODACTYLUS CORTICOLUS Garman.

Brown Globefinger.

I obtained two or three of these new lizards on Rum Key, Bahamas, Jan. 18th, 1888. They were beneath stones, and like all members of this genus that I have encountered, were very agile, moving rapidly with a wiggling, serpent-like motion. In fact, so rapidly did they manage to disappear in the grass, foliage, or beneath another stone, upon being exposed to the light of day, that I only succeeded in capturing some four or five specimens and some of these were mutilated.

All I saw were very small, none being over three inches long. They were brown in color, paler beneath, minutely dotted with darker.

SPHÆRODACTYLUS DECORATUS Garman.

Ornamented Golbefinger.

I collected a single specimen of this very peculiarly marked, little lizard on Rum Key. It was in company with the Brown Globefingers, and although I saw several others, it was impossible to catch them. As soon as the stone beneath which they were hiding, was raised, they at once made a dash for the surrounding herbage, into which they would get, in spite of my efforts to stop them. They moved, with the wiggling motion, so characteristic of members of this genus of which I have spoken. This method of progress is doubtless due to the shortness of the legs, yet these members are moved very nimbly and must greatly assist in locomotion.

SPHÆRODACTYLUS ARGIVUS Garman.

Dotted Globefinger.

I caught two specimens of this pretty little lizard in my house on Cayman Brac, in April, 1888. The inhabitants of the island informed me that they were not uncommon in the houses, but appeared to mistake them for the young of the Wood Slave. In habit, however, they are very different from this species, as I never saw one attempt to climb. All that I saw, some five or six, were hiding under articles of clothing that lay upon the floor.

The Dotted Globefinger is not as agile as the other species of the genus already mentioned, but as crevices are numerous in the floors of the somewhat rudely constructed domiciles on the island, they had always a means of escape convenient, and they were perfectly acquainted with every method of getting into a crevice expeditiously.

These lizards are pinkish brown in color, plentifully sprinkled with dots of brown. Three inches appear to be the extreme length.

LIOCEPHALUS CARINATUS Gray.

Curl-tailed Lizard.

I first met with specimens of this fine large lizard, on Andros in April and May, 1884. They were common on the rough, jagged rocks of the shore, or on the sand in the vicinity of rocks, but never so far but that they could retreat to crevices when disturbed. They are very agile in movement, and when running, the tail is curled two or three times and held upright over the back. This gives the animal a most singular appearance as they go scuttling over the rocks or sand, and has gained for them the cognomen of Curl-tailed Lizard.

During a second visit to Andros, made in December of 1887, I did not see a single specimen of the Curl-tailed Lizard, although I made a careful search for them in every section where I had seen hundreds before; thus it is highly probable that this species spends the colder months in a dormant state, at least as far north as Andros.

The next point where I encountered the Curl-tailed Lizard, was on the island of Cayman Brac, where they were very abundant in the vicinity of the houses and on the rocks along the shore. They are very industrious insect hunters, and I have often seen them enter the houses in search of their prey. Large, old specimens are rather fierce in disposition but quite readily become tame. I brought several north, from Cayman Brac, and they lived all summer, subsisting upon earth worms and grasshoppers.

I did not find this lizard on Little Cayman but it occurs in Cuba. Most of the Bahaman and West Indian Islands appear to have their characteristic species of this genus, but the Curl-tailed is more widely spread.

This species is of an ashy color, banded and mottled with dark brown. The scales are roughened, especially on the head. Full grown specimens measure eight inches or more in length. The legs and tail are proportionately long, but the head is rather large in comparison with the size of the body. The nose is rather short and rounded, and the goitre is not very prominent.

LIOCEPHALUS SCHREIBERSII Gray.

Schreibers' Lizard.

I found this large lizard very common on the Island of Inagua, Bahamas. They are rather agile, but have the habit, in common with other members of the genus that I have seen, of stopping suddenly when in full career, lowering the posterior portion of the body and elevating the head and forepart of the body as far as the anterior legs will permit. They will then remain motionless in this sphinx-like attitude for some time.

Schreibers' Lizard is fond of the hot sun and frequents open spots on the white limestone, basking and happy, in a temperature that would nearly cause water to boil. So far as I observed, they occur all over the more elevated portions of the key, but avoid the lower portions or salinas. They are particularly abundant on the sand of the beaches, especially in the vicinity of rocks, beneath which they find shelter. They also frequent houses and one was in the habit of entering my house regularly, in order to catch flies on the floor. They are grey in color without bands, not unlike the Curl-tailed Lizard but are a little smaller.

LIOCEPHALUS LOXOGRAMMUS Cope.

Gray Lizard.

This is one of the first species that I noticed on Rum Key. They frequent the sandy roads near the shore and the beaches, but I do not think that they occur in the interior of the island. Neither this nor the preceding species curl their tails when in motion, but carry them straight.

This species is smaller than either of the other two members of this genus mentioned, and is much more yellow in color, especially on the sides.

AMEIVA MAYNARDII Garman.

Maynard's Striped Lizard.

On the island of Inagua, some distance back from the northern shore, are ponds or rather depressions which during the rainy season, are filled with water but which at the time of my visit, Feb., 1888, were dry. The space occupied by these ponds and about their borders, was grown up to scanty herbage, only a few inches high. Among these scattering weeds, I found the pretty Striped Lizard which Prof. Garman has kindly named for me.

They are one of the most agile lizards thar I ever met with, moving with such rapidity that it is impossible for the eye to follow them. They appear to keep within the shelter of the herbage, in which they have burrows and to which they retreat when disturbed. In spite of their abundance, I only succeeded in capturing about a dozen specimens, and this I only accomplished by using a noose on a long stick, as they were exceedingly shy.

In color, Maynard's Striped Lizard is black on the back with four lines of yellow extending the entire length of the body. The head, lower portions, and legs are olivaceous strongely tinged with yellow. The form is very slender, with a short head, pointed nose, and a very long tapering tail.

AMEIVA THORACICA Cope.

Lined Lizard.

The island of New Providence, with all of the Bahamas, is composed principally of limestone which is scantily covered with soil. In fact, in many places, the naked rock is exposed without any inorganic covering of any kind, but nature, however, with a lavishness so characteristic of the tropics, has striven even under these adverse circumstan-, ces to remedy this defect, and everywhere in sections where man has not interfered, we find what would otherwise be barren rocks, clothed with verdure. This growth is scanty, to be sure, in places, but when we consider the nature of the substance from which it grows, is comparatively luxurient in others.

This arrangement must have been rather inconvenient to those children of the sun, the lizards, especially to the line lizards that do not climb and consequently would have been obliged to live in the shade a greater portion of the time. Fortunately for them, however, man has come upon the scene, and has made roads and beaten paths in many places on the key. Wherever the limestone is thus exposed, and consequently abraded by passing feet or wheels, it is white. During the hottest portion of the day, when the sunlight falls upon this glaring surface, the air fairly quivers with the intensity of the heat that is reflected with very little absorption from the dry rock. The temperature near the ground is so high as to be far beyond the powers of human endurance, yet these exposed sections are the chosen play-grounds of the Lined Lizards. Here at midday, when even the heat-loving creole has taken shelter from the burning rays of the sun, these little reptiles may be seen chasing one another about or lying flat upon the rock which is so hot that one can scarcely bear the heat on the hand.

At such times, the lizards are extremely active, moving so quickly as to be literally invisible during their passage from one point to another. Then, they are difficult to capture, for if persistently pursued, they will at once take refuge in the shrubbery or herbage, or in the crevices of the rocks. During the cooler portions of the day, especially in the morning, when they have first emerged from their fastnesses, they are a little more sluggish and may then be taken by the aid of a noose on a pole.

This is one of the most abundant lizards on the key and occurs on all of the higher portions, wherever the country is intersected by road or paths.

XIPHOCERCUS VALENCIENNII Dum.

Croaking Lizard.

This singular lizard is not uncommon in the vicinity of Kingston and Spanishtown, Jamaica, and I also found it at Ewarton. They inhabit the dense foliage of the low scrub and herbage, thus appearing to prefer the shade to the sunlight. They are consequently fond of the valleys and do not occur far up on the mountains; indeed they are seldom found even on the foothills.

When frightened or annoyed, especially when handled, they emit an odd croaking sound, quite unlike that given by any other reptile that I ever saw. I have been reminded by Prof. Garman, that the Wood Slave also has the habit of croaking, a fact that I overlooked in my account of it, but which I now find I had noted, yet this latter named species does not utter sounds so loud nor so peculiar as those given by the Croaking Lizards.

The species in hand is very fierce when captured and they defend themselves bravely by struggling and biting. Neither can they be easily tamed, differing greatly in this respect from most of the genus Anolis; in fact, so intractable are they, that they will never cease in their efforts to escape when kept in confinement and will soon die.

The Croaking Lizards are quite pretty, being creamy or pale brown boldly and handsomely banded with darker colors. Fully grown specimens are six or seven inches long, and are rather robust in form, while the head is shorter than in the members of the genus Anolis: nor are the colors changeable.

ANOLIS ORDINATUS Cope.

Brown Anolis.

The genus of which this species is a member, is peculiar in many respects. The most striking character is the power which they all, or nearly all, possess of changing the color of the skin, sometimes from pale green to dark brown or even black, and from ashy to brown or black, or from blue green or malachite green to black, etc., etc., the color varying in different species.

This change of color is effected by a system of vessels that permeate the skin, and which may be filled with a dark pigment at the will of the animal, or perhaps, involuntarily as the animal draws its skin tightly to the body when frightened or angry, or when affected by cold. The normal color of the skin is of some light shade; take for example, our common Green Anolis so abundant in the extreme Southern States, which is of a beautiful yellowish green, when basking in the sun and undisturbed. A careful examination of the dermal covering with the microscope, reveals the pigment vessels closely packed together in the true skin, thus being beneath the epidermis which is nearly, or quite, transparent.

These minute vessels are arranged in clusters, the filaments of which, however, cross and intercross each other. Each cluster has as a base, a pear-shaped reservoir which is situated just beneath the skin, and which forms a connection through a system of vessels with the pigment producing glands that lie on the sides of the loins near the kidneys. When the lizard is about to change color the contracting skin in pressing against the reservoirs beneath it, causes the pigment to flow into the smaller intersecting vessels in the tissues of the skin, thus overcoming its normal color, the change taking place with more or less quickness, according with the intensity of the excitement.

Another prominent character of the genus Anolis is seen in the peculiar extensible gular appendage that lies beneath the lower jaw and throat. Ordinarily, this remains drawn close and then is scarcely observable, but when expanded, it is often of a brillant color between the folds. The mechanism by which this gular appendage is extended, is peculiar.

There is a pair of long, slender. cartilaginous bones that arise between the base of the lower jaws, just beneath the superior larynx, and which are doubtless modifications of the tongue bones. They are hooked at their commencement and fork outward, while between them is a short process extending forward. that connects the two together. The bones then extend backward as far as the folds of the gular appendage goes, that is, to a point between the fore-legs. The bones are separate but lie close together.

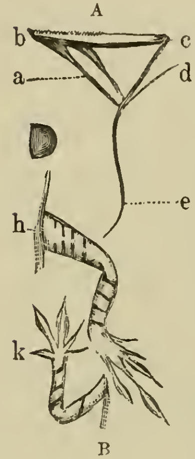


FIG. 20.

In Fig. 20, A, I have given the left side of the lower jaw of a specimen of the common Green Lizard, A. principalis. that was some six or seven inches long: c e is one of the gular bones without the terminal hook, b c, the jaw, b being the termination and c the base. The bones are drawn forward by two pairs of muscles that adhere, one to the terminal portion of the jaw and the other just behind it and to the upper half of the gular bones. One pair of these muscles is given in ib. a. This arrangement draws the skin of the gular sac downward and forward, thus expanding it.

The feet also differ from those of the species already mentioned, in having the three outer toes on both pairs of feet margined with an extension of the skin that forms a kind of lobe; see Fig 20, B, h being the right posterior leg and k the left anterior. It is probable that these margined toes assist the animals in clinging to foliage, as all of the members of the genus are more or less arboreal in habit. The scales are small and inconspicuous. At ib. B is the figure of one much enlarged, taken from the inside of the tibea of the posterior limb. All the other figures are life size.

The Brown Anolis is abundant on the island of New Providence, Andros, and other of the Bahamas, as well as on the Florida Keys. This wide distribution is quite likely due to the constant commercial intercourse existing among the inhabitants of these places.

These lizards, like all others of their near relatives, are very agile but they run more nimbly over the rough rocks and stones than some of the species, while on the other hand, they do not leap about among the foliage with as much agility as do some of the species. They are common, remarkably common, in fact, in the vicinity of houses, and often enter them in search of insects, running nimbly over the walls to catch them.

The adults are rather plainly colored, their normal hue being brown from which they change to black; the gular appendage is red. The young are marked on the back with a series of dark brown oval spots, more or less connected together and arranged in two lines. I do not think they change color in the earlier stages of growth, or when thus marked and are then more arboreal in habit, frequenting the numerous air plants, among the leaves of which they hide.

ANOLIS LUTEOSIGNIFER GARMAN.

GRAY ANOLIS.

The Gray Anolis is common on the island of Cayman Brac. They are generally distributed but are by far more numerous in the cocoanut groves, living on the stems of the trees, around which they run with great agility; then if hard pressed, will retreat to the shelter of the tops and hide among the nuts and fronds.

I also found this species on the island of Little Cayman, but here they were not as common as on Cayman Brac. They were most numerous in the vicinity of the little settlement on the south shore, near the west end of the key, hence it is probable that they were transported from one place to the other by the inhabitants.

In normal color, this lizard is gray but changes to very dark brown or nearly black. The gular appendage is very nearly orange but never red. The young are marked much as are those of A. ordinatus.

ANOLIS MAYNARDII GARMAN.

MAYNARD'S ANOLIS.

I discovered this fine lizard on the island of Little Cayman where it is not common, being confined, as far as I observed, to the western end of the key. It was with difficulty that I captured any specimens, as the only place that I found them, was on the walls of the buildings belonging to a phosphate company, which I was kindly allowed to occupy by their agent, Mr. Hunter. They were usually quite high up on the walls, often beneath the eaves, and when low enough to reach they generally managed to elude me.

The problem of the distribution of animals is often difficult to solve, and the presence of this lizard on this little key, on a limited portion of it, in fact, presents one of these very difficulties. Did they originate here?

(CONTINUED.)

NOTES ON THE ANATOMICAL STRUCTURE OF THREE SPECIES OF GANNETS.

The following notes are based on observations that I have made upon three species of Gannets; viz., the Booby Gannet, Sula sula, Cory's Gannet, S. coryi, and the Common Gannet, S. bassana. As these birds represent three groups of gannets, as shown in my article on the evolution of the totipalmates, these notes, although very far from offering a complete history of the subject, seem worthy of publication as they exhibit important structural differences between the species in hand.

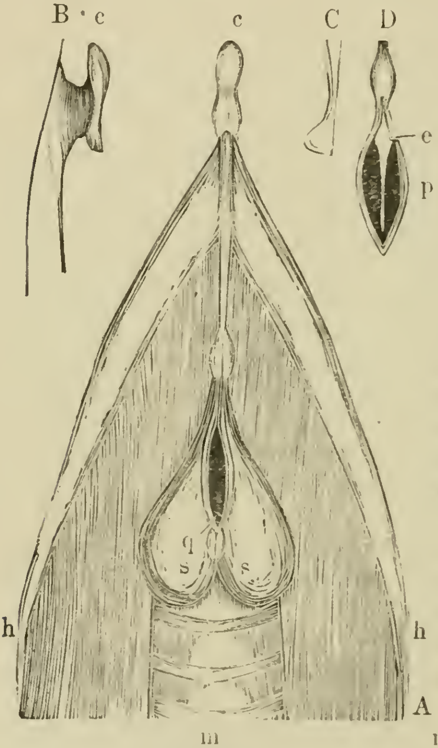
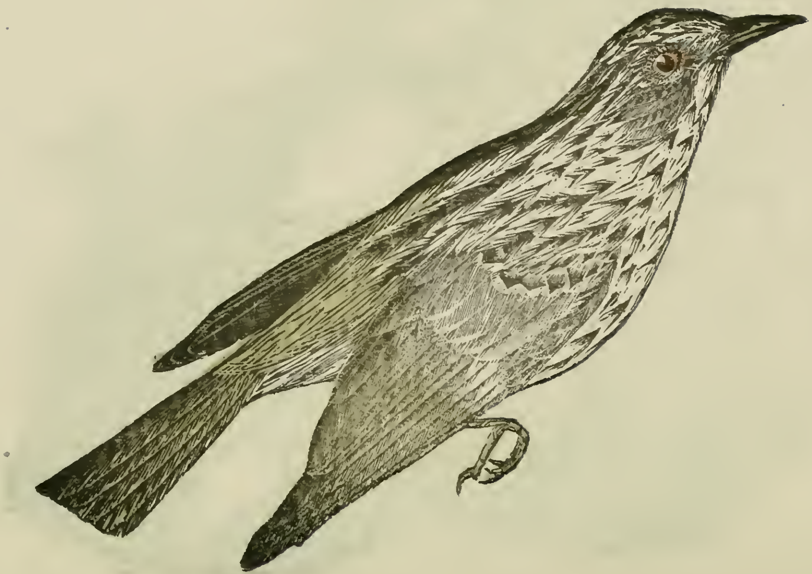


FIG. 21.

Singularly enough, some of the most striking variations are to be seen in the tongue, superior and inferior larynx, characters which are usually alike in birds so closely allied as are these gannets. As the Common Gannet possesses some peculiarities of these organs, utterly unlike anything seen in the other two, I will first give an account of this species.

The tongue of the Common Gannet is in some respects one of the most singular that I have ever seen. It is short, about .50 long, thick and fleshy, rounded at the tip, slightly contracted in the middle, and bifid on the posterior portion. Fig. 21 A, c. But the most noticeable feature is its elevated position, seen in a side view, at ib. B, c. The bone that supports it, the basi hyal, is bent downward and the tongue is thus raised above the plain of the muscles about once its thickness. The whole strikingly resembles a moccasin clad human foot, having a bifid heel. The tongue of the Chimney Swift is bent something like this.



EXPLANATION OF FIGURE ON PLATE IX.

Dendroica pharetra Gosse, Arrow-headed Warbler, of Jamaica. adult.

Other bones of the tongue are well developed, and the thyro-hyal, Fig. 21, h h are surrounded by powerful muscles. It is therefore probable that although the tongue adheres below to the skin of the gula sac, it is retractable, and hence not quite functionless, as this organ must be in the Pelicans.

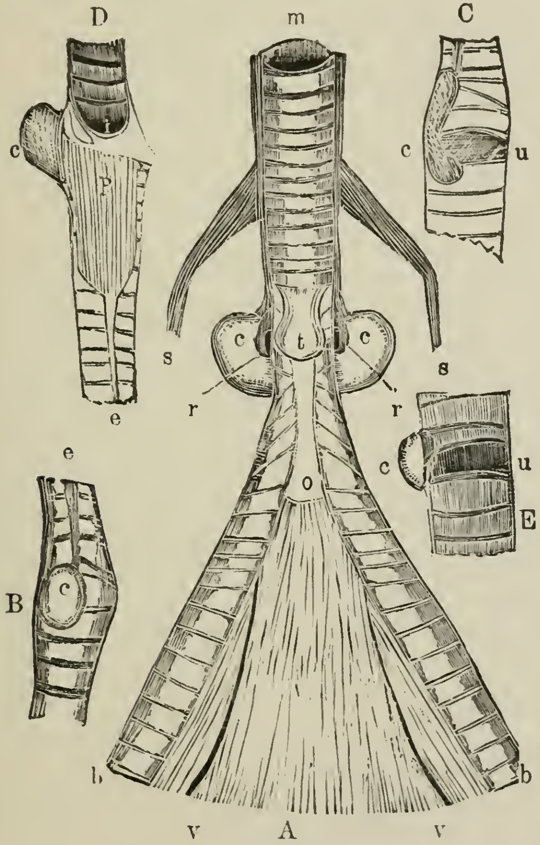


FIG. 22.

The superior larynx is situated at some distance from the base of the tongue, 1.40, and the entrance to the trachea which is a slit .60 long, ib. q, is closed by strong muscles, ib. s s. Within the entrance, extending backward, is a thin cartilaginous bone or septum, against which the lips of the muscles that guard the entrance, close; see ib. D, where is given a view of the tracheal orifice, q, open, and within it, is the septum, e, while at D is a side view of it, base upward, the free end being widest. The whole structure is supported by a Y-shaped bone which extends forward from the first tracheal ring, Fig. 25 A, b, as seen from below, m being the first tracheal ring and c the lower side of the septum, the intervening portion of the trachea being removed, while ib. B shows a section across the lower portion of the larynx, b being the base of the Y-shaped bone. The trachea is flattened at the superior larynx, where it is about .75 wide; see fig. 21 A, m, but as it descends, it becomes gradually rounded and narrower, and is without dilatation or special enlargement anywhere. It measures 11.50 to the inferior larynx.

The sterno trachealis, Fig 22, s s, is well developed and there is a thin strip of a bronchialis arising at the base of the lower side of the sterno trachealis and extending over the two upper laryngeal half rings, see Fig. 22 B, e. Below these muscles and adhering to the sides of the larynx, are two singular hemispherical bodies, yellowish white in color, see ib. A, c c, where a view of the lower side is given, which have been considered by some authors as the rudiments of a second pair of thyroid glands. I am inclined, however, to think them the shrunken thymus glands, as they contain an oily matter and as the thymus glands are enormously developed in young gannets. The question can be easily settled by examining the young of the Common Gannet when a few days old and later, in order to note the gradual diminution of the thymus.

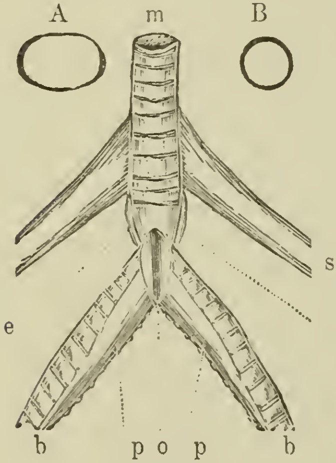


Fig. 23.

It is quite possible that it may have an attachment to this portion of the larynx from the first, but what function it can have thus attached is difficult to determine; at all events it appears to be unique in this species as no other bird that has come under my notice has anything like it.

This gland is not attached to the larynx by its entire base but only adheres along its upper side, see ib. C, where I have given a view of the left side of the larynx with the gland removed: the shaded portion at c shows the points of adhesion. Beneath the gland, and partly covered by it, is a vibrating membrane, lying between the third and fourth bones of the larynx, see ib. u where there is an outside view of the vibrating surface, and F, u, where is given an inside view, c being the gland. On the lower side of the glands, is an orifice open that extends over the membrane, back to the point of the attachment of the gland to the larynx, see ib. A, r r. At ib. B, c, is given a side view of the gland.

The bronchial tubes are long, ib. A, b b, and are composed of about twenty-three half rings. They diverge at their junction with the larynx, at a considerable angle, Fig 25 C, o, where is given a view of the upper portion of the larynx, the other parts being lettered as in the other figures. Below, the division is concealed by the lower bone of the larynx, Fig. 22 A, t. At their junction with the larynx, the bronchial tubes are narrow, Fig. 25 B, d, but rapidly become wider, ib., b, and Fig. 22 A. b b.

On the inside of the tubes at their very beginning, are wide tympaniform membranes, that continue about the same width and occupy very nearly the entire inside of the bronchials for about six half rings, at a point near o, Fig. 22 A. Then they suddenly narrow to a slight division between the bronchial rings, and so continue to the lungs, see ib. D, p being the wide portion of the right tympaniform and e the narrow.

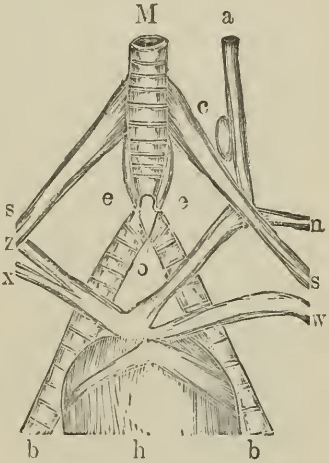


Fig. 24

At the point where the tympaniforms narrow, a membraneous muscle begins stretching across from tube to tube, and adhering to them along the lower edge of the narrow tympaniforms, see Fig. 22 A, o v v. The muscle is thin but strengthened by two ridges of thick fiber, ib., v v. The function of this muscle is to draw downward the upper portions of the tubes and thus render tense the wider portions of the tympaniforms.

The upper portion of the tympaniforms have their beginning in the acute angle of the bronchial tubes, Fig. 25 C, o, where a diagramatic section is given, are attached to an os transversale, seen in the unshaded portion, Fig. 22 B, between p and i, and this bone bears a very narrow semiluna membrane, so narrow, in fact, as to be nearly or wholly functionless, see ib., i.

In external characters, the nearest ally of the three species, to the Common Gannet, is Cory's Gannet, but the tracheal organs differ greatly as does the tongue. This organ is .56 long, flattened and triangular in form, see Fig. 26 F, c, and the thyro-hyals are provided with quite strong muscles, proportionately as strong as in the Common Gannet, ib, h h. The distance between the base of the tongue and superior larynx is short, about .50. The superior larynx differs greatly from that of S. bassana, and the mechanism for closing the orifice is peculiar; ib. s shows the larynx and q the slit opening into the trachea, m. Back of this opening, supported by a small bone, is a cube-shaped muscle that is drawn downward and forward, when the bird wishes to close the entrance to the trachea, thus coming in contact with the lower wall of the larynx and the projection extending backward from the base of the tongue, see ib. A, where I have given a sectional view of the superior larynx; c, is a portion of the basai-hyal bone, q the side of the opening to the larynx, A the muscle over the closing valve, and e, the valve with the supporting bone in the center.

The trachea of Cory's Gannet is much flattened at the superior larynx, see Fig 23 A, where is given a section at the first ring, but becomes smaller as it descends, see ib. B, where is given a section of the trachea at the junction of the sterno trachealis, and thus there is no dilitation of the trachea.

The sterno tracheal muscles are very large, see Fig 23, s s, Fig. 24, s s, and Fig. 26 E, s.

The bronchialis is represented by thin, strap-like muscles, seen in Fig. 24, e e, Fig. 23, e e, and Fig. 26 E, e. These muscles extend from the base of the sterno trachealis to the first laryngeal half ring, and their function is to render tense the laryngeal vibrating membrane seen at u, Fig. 26 F.

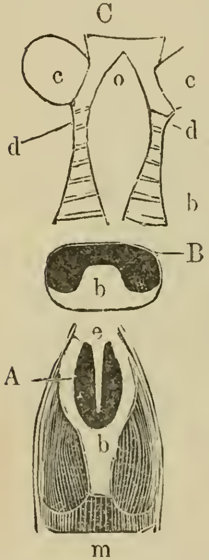


Fig. 25.

The tympaniform membranes, Fig. 23, p p, are long and wide, occupying the entire length and width of the bronchial tubes, the outside one of which is given in Fig. 26 E, v, and there is a much less prominent membraneous muscle connecting the tubes than in S. bassana.

The os transversale is present but there is not even the rudiment of a semiluna membrane, as seen in the Common Gannet, while there is no shield-like projection of the larynx over the lower side of the division of the bronchial tubes. compare t o, Fig. 22 A, with o, Figs. 23 and 24: nor do the tubes narrow as much at the laryngeal termination as in

S. bassana; see Fig. 25 C, d d and compare with Fig. 24, o e e. The larger vibrating surface of the tympaniform membranes of Cory's Gannet, compared with that of the Common Gannet the laryngeal vibrating membranes being the same and counting out the mere rudiment of the semiluna seen in the Common Gannet, as this is without doubt, functionless, should give to this species a greater power of voice. In fact, such is the case, and I have heard Cory's Gannet give more notes than I ever heard the Common Gannet utter, but the cries of both are very harsh and discordant.

In Cory's Gannet, as remarked, there is no indication whatever, of the singular gland which I have called the thymus, adhering to the larynx, but there is a rudimentary thyroid present attached to the single carotid artery. This is a small elliptical body, about .25 long and lies on the inside of the carotid, the left of which only is developed, see Fig. 24, a being the carotid artery, c the thyroid gland, h the heart, n, w, x, and z, other arteries. The thyroid is quite likely functionless or nearly so; I judge this to be a fact, as the gland is of such a small size. In a young Great Blue Heron, but fully grown, that I have recently dissected, I found two thyroids one adhering to each carotid artery, but the left thyroid was nearly twice the size of the right, and in it I found some well developed, cylindrical glands, each of which was fastened by its inner, terminal extremity to

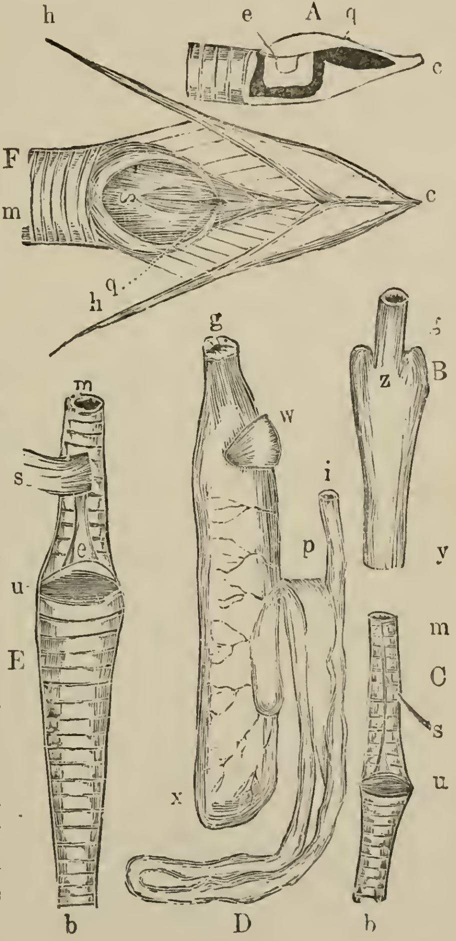


Fig. 26.

the outside of a small vessel, not a branch of the carotid, that passed through the gland. The right thyroid in this bird also had a small blood vessel passing through it, but I could find no developed glands.

In the only specimen of the Boody Gannet that has come into my hands to dissect, I find that I have made no notes nor drawings of the appearance of the tongue nor superior larynx. It may be possible that these organs were missing from the body that was kindly given to me by the Bangs Brothers of Boston, who obtained the bird, a young male, in the Quincy Market. where they were informed. that it was taken on Cape Cod.

The trachea is simple. without dilatation, and is rounded for, at least. the lower half but is slightly enlarged at the inferior larynx.

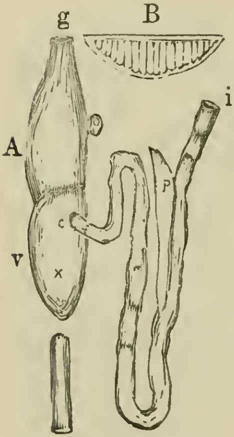


FIG. 27.

The sterno trachealis is comparatively slender and has its origin about .50 above the laynx, see Fig. 26 C, s. m being the trachea and b the bronchial tube. There is a thin staplike. bronchialis muscle arising some distance above the junction of the sterno-trachealis with the trachea, and passing below it, adheres to the first tracheal half ring. see ib. u.

Below this muscle. and rendered tense by it, is a laryngeal vibrating surface, see ib. u.

The bronchial tubes are composed of twenty or more half rings and adhere together at their laryngeal junction. for the space occupied by five half rings. Below this. are small tympaniform membranes.

The œsophagus of the Booby Gannet is dilated, and opens into a wide proventriculus which is 1.80 long and which emerges into the stomach without any constriction. See Fig. 26, where is given the stomach and adjacent organs, about two thirds life size: the proventriculus begins at a point just below g. where is given a small portion of the gullet, and extends to a point about opposite p. The proventriculus at its junction with the stomach, is .70 in diameter. The glands are placed in five longitudinal ridges, and are simple and cylindrical in form.

The stomach is a cylindrical sack with soft, thin walls, and lined with a soft mucous membrane that is raised in five ridges. continuous with those of the proventriculus. Its length is equal to that of the proventriculus.

The intestine emerges from the stomach at a point about one half its length from the terminal end which thus becomes a cul-de-sac, see Fig. 26, x; it passes upward for 1.00, then bends downward for 2.85, again bending upward. forms the part of the duodenum which measures about 3.00 in length.

The prancreas occupies less than one half of this fold, the upper; see ib.. p. Its length is 1.70.

The intestines are not long. and there are slightly developed cœca, ib. B, z. where it is represented as being life size, and g being the intestine and y the rectum.

The spleen is an irregularly formed body, lying on the proventriculus, see ib. w.

The œsophagus of Cory's Gannet is dilatable and is 10.50 long and opens into a wide proventriculus, .90 in diameter for its entire length, see Fig 27, A, where is given a cut about one half life size. The glands are numerous and lie in longitudinal ridges. They are cylindrical in form, (see ib , c,, where is given a figure of one greatly enlarged) but are of unequal length on account of the convex form of the ridges, see ib. B. where is given a life size section of one of the ridges.

The stomach. ib., N. is divided from the proventriculus by a slight construction, and is 1.90 long by .85 wide.

The intestine emerges from the upper part of the stomach, ib. c being the lower portion, x. a cul-de-sac, preceeds outward for .45, then bends upward at right angles for 1.35, turns upon itself downward for 3.75, then again bends upward to form the fold of the duodenum which is about 4.00 long.

The pancreas, ib., p, occupies only about one half the length of the duodenum. and adhers to the intestine only on one side, not to both as is usual in most birds.

The intestine is not long nor very large, measuring about .30 in diameter.

The cœca are represented by a mere swelling in the intestine, see Fig. 15, page 81, where is given a life size view of it.

The spleen is a globular shaped body lying on the proventriculus, see Fig. 27, o.

For description of the digestive organs of the Common Gannet and a summary of the preceding article, see a continuation of this subject in a future number of Contributions.

SINGULAR CAUSE OF THE DEATH OF A WHITE-BELLIED NUTHATCH.

On September 25th., a White-bellied Nuthatch, Sitta carolinensis, was brought to me, with an acorn shell attached to its beak, that had evidently been the cause of its death. The kernel of the acorn had been removed, probably through the agency of a squirrel, and the shell had become quite dry, and consequently hard and horny. The rodent in manipulating the nut had gnawed a hole in both sides, and the orifice on one side chanced to be broken in a peculiar manner. Directly in the center of the upper portion of the acorn, and consequently in the center of the orifice, for this was about in the middle, a spur of shell projected downward, see Fig. 28, where I have given a view of the acorn shell, top down, and the projection may be seen at c.

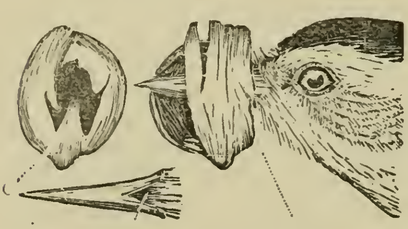


Fig. 28.

Now this simple shell lying on the ground or lodged on the limb of a tree, must have been an innocent looking object, yet it proved as fatal to this Nuthatch as would have been a charge of dust shot. It is probable that either some insect had found a lodging in the empty shell or that some bits of the kernel remained. It is most likely that the insect was there, at all events, something induced the bird to thrust its bill into the cavity. It must have gone further in than the Nuthatch intended, passing completely through so that the spur, ib. c, slipped entirely over the lower mandible, and being somewhat elastic, pressed upward into the V-shaped depression at its base, see ib. b; at the same time the broken edges above pressed firmly against the rather flat top of the base of the upper mandible, keeping the bill closed. So closely did the spur (seen in side view at ib. a) hold the shell in place, that all efforts of the bird to dislodge it proved futile. Thus the Nuthatch perished, not from hunger for there were remnants of food in the stomach, nor from suffocation for the nostrils were free, but from worry, just as some birds die when newly caged. The bird was picked up in Waltham, and the skin is now in the collection of Master Roy M. Baker, to whom I am indebted for the privilege of illustrating the head.

DISEASED FEET OF A CHIPPING SPARROW.

On Sep. 10th a Chipping Sparrow, Spizella socialis, that had the feet diseased in a singular manner, was picked up dead in the street, by a young lady, and brought to me.

A cancerous growth, partly soft and partly hard, had attacked the feet, tarsi, and most of the toes, while it had extended to the lower portion of the tibia of one leg. The right foot was the most affected, the disease extending over the entire posterior toe, see Fig. 29 A, a, where the inside of the foot is illustrated, excepting a portion of the nail, and covered the basal joints of the anterior toes, while the middle toe, ib. c, has an additional detached tubercle on it. The tibia, ib. g, is not affected noticeably.

The left foot is not quite so much enlarged, see ib. B, where the inside of the foot is represented, but the posterior toe is twisted forward and partly covered, ib. d; the middle toe, ib. e, has a large, globular, terminal lump, completely covering the nail. This tibia, ib. b, is much swollen.

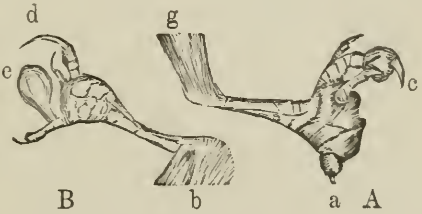


Fig. 29

That the bird managed to exist in this distressing condition, is singular. As it was young, hatched this year, it is possible that it was fed by its parents sometime after it was fully grown, then when finally abandoned by them died. It appeared much emaciated and I had intended making a more thorough examination of it, but unfortunately it was eaten, feet and all, by a cat which up to date, however, has exhibited no signs of having been affected at all, by this unique meal.

MONOGRAPH OF THE GENUS STROPHIA.

(Continued from page 79.)

Since writing the article on S. incana, I have received, through the kindness of Dr. Velie of Chicago, specimens of a striped species of Strophia, from Key Vaccas, Florida, that is evidently the shell that Binney figures as a striped S. incana. For proof that this is a distinct species, see forthcoming article under the head of S. fasciata, where this species is described.

21. STROPHIA INFLATA.

Swollen Strophia.

Plate VII, 21 & 21 a, shell: Fig. 30; A, front, B, left side.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, heavy. Striations are absent. Whirls, 10. Teeth, two, and short. Examined 25 specimens.

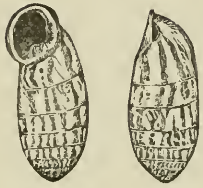


Fig. 30.

Form of shell, cylindrical, with the second and third whirls the largest in diameter, the first and fourth are a little smaller, the fifth is considerably smaller than the fourth, and from this, the shell slopes rapidly to a blunt rounded, nearly hemispherical apex, forming a wide angle of nearly 90 degrees. The surface is polished but is slightly furrowed with lines of growth, which are much less prominent on the lower whirls. The sutures are shallow, and the whirls between them are slightly bulging.

Aperture, of medium size but open, and measures considerably more just within than at the entrance. Lower tooth, very slightly developed and is raised by gradual elevation from the surrounding surface. It is about .10 long. The upper is situated considerably above, is about as prominent, but is more conspicuous within.

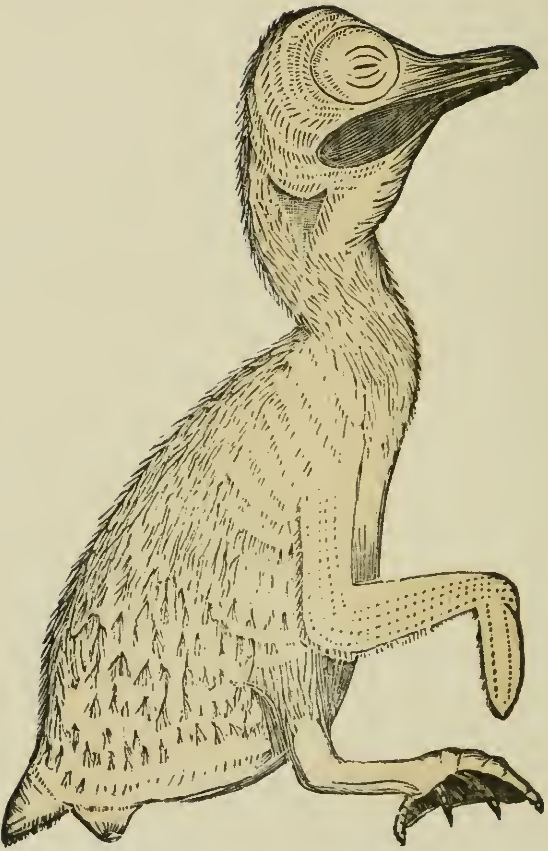
Margin, not produced forward as far as the diameter of the shell, is inclined slightly backward and a little to the right: it is not thickened and the outer portion is produced into a thin but not prominent edge which is not rolled downward. The frontal bar is not prominent, being interrupted in the middle.

Color of shell externally, white, conspicuously striped with yellowish brown that becomes nearly yellow on the lower whirls, and which occupies the last two, wholly excluding the white. The margin, frontal bar, and teeth are yellowish, and on the lower wall, within the aperture, are purplish brown stripes that merge into the universal purplish brown of the interior.

DIMENSIONS.

Size of types, .90 by .35. Largest specimen, 1.00 by 37: smallest, .90 by .35. Longest specimen, 1.00; shortest, .90. Greatest diameter, .37; smallest, .35.

PLATE XI.



EXPLANATION OF FIGURE ON PLATE XI.

Sula coryi Mayn., Cory's Gannet, young, about two days old, taken on Little Cayman, April 24, 1888. Life size; drawing made from a recent specimen.

OBSERVATIONS.

Although in some specimens the first whirl is but little smaller than the second, it is always some smaller, and in the majority of cases, noticeably so, and also in many instances, the third whirl is larger than the second. There is a decided inclination among some individuals, to have the margin slope considerably backward, thus possibly constituting a form. The markings described are very constant, as well as the number of whirls.

This well marked species may be at once distinguished from the short toothed Strophias, by the inflated lower portion, absence of striations, heavy shell, and stripings.

DISTRIBUTION AND HABITS.

The Swollen Strophias occur at Salena Point, Auklin Islands, Bahamas, where they were collected by Dr. Henry Bryant of Boston, many years ago. I obtained the specimens from which I made the above description, from the collection of the Boston Society of Natural History, where through the courtesy of Mr. Samuel Henshaw, I was permitted to examine the Strophias.

STROPHIA MARITIMA PFR.

Seaside Strophia.

PUPA MARITIMA PFEIFFER, Wirgm. Arch., 1839; I, p. 353.
Plate XIII, 1 & 1a, shell: A, front, B, left side.

DESCRIPTION.

SP. CH. Size, rather large. Shell, heavy. Striations, absent. Whirls, 11. Teeth, rather short. Examined 50 specimens.

Form of shell, an elongated cone, inclined to be cylindrical, with the first and second whirls equal in diameter, the third is but little smaller, then the shell tapers to a rather acute point, forming an angle of 60 degrees. The surface of the shell is not particularly smooth, being somewhat thickened by lines of growth and some few excrescences. The sutures are not deep, and the three upper whirls between them, are only slightly bulging, the remainder not at all.

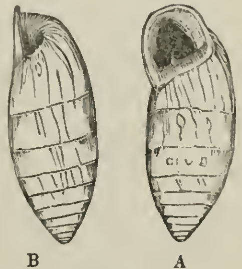


FIG. 31.

Aperture, large and open, narrowing quite rapidly within, attaining its minimum size about .15 from the outside edge of the margin. Lower tooth, not prominent, and is situated a little to the right of the center. It is about .03 high and .10 long. The upper is situated just above it, and is represented by a mere elevation, as seen from the outside, but attains some prominence within.

Margin not produced forward quite as far as the diameter of the shell, does not slope backward, but is inclined considerably to the right. It is thin and the edge is rolled backward into quite a prominent, though blunt edge. The frontal bar is complete, but not prominent.

Color of shell, externally, chalky white; internally, gradually becoming yellowish.

DIMENSIONS.

Size of specimen figured, 1.25 by .47. Largest specimen, 1.30 by .50; smallest, 1.20 by .45. Longest specimen, 1.30; shortest, 1.25. Greatest diameter, .50; smallest, .45.

OBSERVATIONS.

The Seaside Strophia is allied to S. incana, from Key West, but differs in being heavier, larger, with a more open aperture, and a somewhat flanging margin; this last named character being possessed by many Cuban species. It belongs to a group of smooth, thin-margined, short-toothed Strophias, and may be distinguished by these characters combined with the open aperture, rather flanging margin, and pure white color.

The shell here figured and described is unquestionably the Pupa maritima of Pfeiffer, and was kindly given me by Prof. H. A. Ward, of Rochester, who obtained it from Punta de Maya, Matanzas, Cuba, and this is the locality from which Pfeiffer's type came.

DISTRIBUTION AND HABITS.

Matanzas, Cuba, is the locality from whence all of the undoubted shells of this species, that I have seen, came. I have never met with it living, thus know nothing of its habits.

23. STROPHIA DALLII Novo.

Dall's Strophia.

Plate XIII, 23 & 23a, shell. Fig. 32, front, A, transverse section; O, upper, terminal portion of channeled tooth; c, frontal bar; e, channeled tooth, enlarged. Fig. 33, left side.

DESCRIPTION.

Sp. Ch. Size, rather large. Shell, heavy. Striations, present. Whirls, 10. Teeth, two, the upper inconspicuous, the lower extremely long and channeled. Examined 25 specimens.

Form of shell, cylindrical, with the first three whirls of the same diameter, the fourth is but little smaller, and from this the shell slopes to a rather blunt point., forming an angle of 60 degrees. The sutures are very shallow, and the whirls between them bulge but little

The striations are very numerous, 50 on the first whirl, are not arranged in lines, yet are quite regular; they are slightly inclined from right to left, and the interspaces are a little narrower than the prominences. The striations are rounded on top and polished.

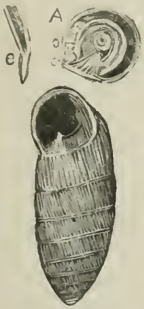


Fig. 32.

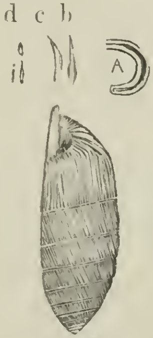


Fig. 33.

Aperture quite large and open, but narrows rather rapidly within. The lower tooth is not very prominent, but extending backward along the lower wall about .15, becomes widened and channeled, and in this form passes downward, terminating on the right side of the third whirl; its length is thus about .75'. Its position is a little nearer the column which it encircles, than to the outer wall. (See Fig. 32, A, where is given a life size view of the upper portion of the tooth, the top of the shell having been removed; o, shows the tooth; c the frontal bar.) The upper tooth is a mere prominence, but gains in size as it passes backward, and makes a complete turn around the column.

The margin is not produced forward beyond the diameter of the shell, slopes slightly backward, and is a very little inclined to the right, is rather thick, measuring .06, and the edge is rolled slightly backward, but is not thin. Frontal bar, well developed, and the lower wall of the aperture within it is smooth, but the striations are slightly apparent beneath the enameling.

Color of shell, externally, shining white, sparingly mottled with reddish, but more prominently on the smaller whirls. The outer margin is white, but within, there being an abrupt line of demarkation, it is dark purplish brown.

DIMENSIONS.

Size of type, 1.20 by .42. Largest specimen, 1.22 by .45: smallest, 1.18 by .40. Greatest diameter, .45: smallest, .40. Largest specimen, 1.22: smallest, 1.18.

OBSERVATIONS.

Specimens do not vary essentially from the type. This is a remarkable shell. In it we find the maximum number of striations, no other known species having so many. It may be considered the type of a group of Strophias having the peculiar channeled, greatly elongated tooth. These, as far as my present knowledge extends, are confined to the island of Inagua, where all of the species of Strophia are thus characterized.

By the teeth alone, the Strophias may be divided into at least four sharply defined groups, as follows:–

LOWER TOOTH, GREATLY ELONGATED, CHANNELED: POSITION, CENTRAL.

Lower tooth, projected backward along the lower wall, at least beyond the first whirl and channeled excepting on upper termination. (See Fig. 32, A, where is given the upper termination of the channeled tooth of S. dallii; o, being the tooth and c, the frontal bar; e is the upper termination greatly enlarged, showing beginning of channel. At Fig. 33, A, is the lower termination of the tooth of S, pallida.) Habitat of species, Inagua, Bahamas. Type, S. dallii.

LOWER TOOTH, ELONGATED, SIMPLE; POSITION, CENTRAL.

Lower tooth, projected back into the aperture for a distance at least four times its height, but it is not channeled, being a simple pyramid. (See Plate II, 1c, where a side view of the elongated central tooth of S. pannosa is given; in Fig. 33, a top view of the same is represented; at ib. c, is given the top of that of S. copia; the top of that of S. nana is figured at ib. i.) Habitat of species, the Cayman Islands. Type, S. pannosa.

LOWER TOOTH, SHORT: SIMPLE: POSITION, CENTRAL.

Lower tooth, short, its length being no more than three times its height, and its position is about central. (See Plate VII, 17b, where is given a side view of the short tooth of S. alba, and Fig. 33, b, where is represented the top of the tooth of S. neglecta.) Habitat of species, Bahamas, —excepting Inagua— Cuba, and probably Hayti. Type, S. neglecta.

LOWER TOOTH, SHORT; SIMPLE; POSITION, NOT CENTRAL.

Lower tooth, very short, its length being no more than twice its height, but its position is considerably to the right of the center, being, in fact, placed nearly on the column. (See Fig. 34, A, where is given an enlarged cut of the teeth, lower and upper, of S. uva, showing the near proximity of the two, and the position of the lower, almost on the column.) I cannot at present clearly define the habitat of the species of this group. It is, however, safe to say that they are found on the more northern of the Windward Islands, and some of the keys off the north coast of South America—Curacoa and vicinity. Type, S. uva.

[NOTE. The material examined upon which the foregoing conclusions are based, consists of at least three fourths of the known species of Strophia. Of course among the large amount of fresh material to be gathered, for without doubt, nearly every island among the Bahamas and other West Indies, not yet explored for Strophias, will yield one or more species, forms may occur that will, perhaps, cause me to modify my ideas somewhat, but I have considered it best to give this exposition of my studies upon the group up to date, in order that students may better understand my descriptions. Further remarks upon this head will be given under General Conclusions.]

An understanding of these groups, as defined, is of great importance in determining species in Strophia. Of course, other characters are often constantly found in a given group. For example, the Inagua Srophias, having the channeled tooth, are nearly always cylindrical, the the first three whirls being about equal in diameter, while the striations are fine and numerous. Both of these characters are also found in the short toothed group, but here they are not constant, nor do they always occur together. Other groups possess other characters, to be mentioned elsewhere. In fact, it is nearly always possible to find species in one group that bear a superficial resemblance to others in different groups, when they are really utterly different.

The sharply defined difference in the teeth, as pointed out, becomes of more importance when we consider that specific characters are much less prominent in Strophia than in many other genera of shells, although as constant as those more easily perceived. Thus these groups become, in a measure, sub-generic.

It is a well known fact that in some genera, or even families, in all classes of animals, species are much more closely allied than in others, and that certain characters are constant in some genera, thus are available in defining species, which are inconstant and thus valueless for this purpose in others.

Any naturalist, not narrowed down to a specialty, will acknowledge the truth of the above made statement, as his attention must be constantly called to it in his investigations.

Again, we must acknowledge that groups of animals in which species are not readily defined, require the closest study in order to clearly understand just what characters are of value in deciding specific rank.

The genus Strophia presents one of these very problems, and whether from the difficulty of recognizing species, or from some other cause, has been strangely neglected, as I have had occasion to remark many times, by naturalists on this side of the Atlantic. It is true that there is quite an extensive literature upon Strophia in connection with Pupa, but very much of this is valueless on account of too great generalization in describing species. Then again, two, or more, species are often included under one name, consequently descriptions become very confusing.

I may appear to be making a sweeping statement here, but am sure that I am correct in this assertion. As proof of this I have only to bring forward the fact that in some of the largest collections in the country, that have been examined by me, names are applied to comparatively few species, and when applied are often obviously wrong, as the same name is, in many cases, appended to more than one species, while on the other hand, instances are not wanting where the same species has received different names!

Now I do not pretend that I have done any more than any one can do in the study of Strophia, who has modern ideas regarding species and the requisite training. But I have given the subject very much attention and thought. It is true, that I have much to learn, for there is a broad field still before me, but as far as I have been the matter appears perfectly clear to me.

I cannot help feeling that many conchologists, at least in America, are unfamiliar with this genus through prehaps having neglected it as of not sufficient importance to warrant the application and thought that the subject merits. I may say, however, that since the appearance of the first number of my monograph, I have met with much kindness, as well as encouragement, from many prominent naturalists who have aided me in many ways in prosecuting my researches.

I wish to emphasize the assertion. made before, that no one species of Strophia, with rare exceptions, is found on different islands, unless recently transported by commercial intercourse. Two instances where this has occurred, are in S. copia and S. intermedia, and I must now record another. Among the Strophias belonging to the Smithsonian Institute are a lot of undoubted S. inflata, labelled as coming from Exuma, the type being from the Bryant collection, taken at Salina Point, Auklin Island, 100 miles distant.

Of course in making the above written statement I do not wish to be understood to say that simple geographical bounderies constitute specific rank. As shown in many instances, Strephia is an exceedingly plastic genus: that is, for some reason, now beyond our knowledge, species become evolved quite readily, and in conformity with a law of evolution, most readily toward the center of the greatest distribution of the species. Hence it is, that if by any chance, some members of a species become isolated, either by being transported to a separate island, or to some section of the same island where they are isolated by the surroundings, and as pointed out already under the habits of S. nana, comparatively little is necessary to so isolate them, they are apt to speedily assume specific characters. This is, prehaps, caused by different environment, different food, or possibly wholly by an inherent tendency to vary from the parent stock.

As shown, especially under observations in S. copia, there is a great tendency to assume forms, under apparently the same environment, and these forms generally indicate the specific characters that will be assumed by isolated individuals. For example, I find that among a large series of S. incana from Key West, some few individuals which show faint indications of brown fleckings, and Dr. Dall writes me that in the Smithsonian collection are specimens of undoubted S. incana that are flecked. Now this is exactly what I should expect to see, for it is in perfect accordance with the law of evolution of which I have been speaking, and clearly indicates the flecked S. fasciata found at Key Vaccas.

Now through the operations of the well known law of reversion, (a law too much ignored by naturalists practically, although generally recognized by them,) individuals among nearly all species, especially if recently evolved, will show a tendency to revert toward the parent stock; this is eminently true in Strophia, and to this cause, in connection with the foreshadowing of species, explained above, is due much of the apparent confusion in many species which are closely allied, but really distinct.

In studying Strophia, I have always endeavored to first thoroughly understand the intricacies of the oscillations of individual variation. —greater in some species than in others—then have indicated the more or less set forms that have passed beyond mere individual variation, but which have not lost the links that bind them to the parent stock; thus have been prepared to recognize species, even if closely allied, wherein there are no true connecting links.

In concluding this digression, which I have considered necessary to make at this time, I shall recapitulate somewhat in the following remarks, in order to emphasize some of my assertions.

The genus Strophia is larger and much more important than has been supposed. On this side of the Atlantic, at least, it has been much neglected, and consequently many collections are in a sad state of confusion regarding proper names being appended to species. Many easily recognized species have received the same name, and the same species sometimes bear different names in the same collection, (in one instance two lots of one species labelled as coming from one locality, have received different names, both of which are in the same handwriting!) while in many cases the same species bears different names in different collections. Much of this confusion is due to the fact that, with a few exceptions, writers upon Strophia, especially the older authors, have not given enough attention to details, hence one description often embraces more than one species. They have scarcely ever recognized the importance of isolation as indicating species, and are thus apt to assign too wide a range to one species.

Many students of today in endeavoring to identify species by these descriptions have tried to make too few names fit too many species, and through an unfamiliarity with the subject, have not observed their error.

Individual variation is sometimes comparatively great in species of Strophia, yet this has its limits, becoming overbalanced into forms, and these, in turn, into species. A tendency to indicate the species that has been evolved through the isolation of individuals, by a greater or less prominence of some particular character, on one hand, and reversion in some specimens of that recently evolved species, will sometimes form what are apparently connecting links between the two species. Such apparent links are, however, always represented by a very small percentage of specimens, and a close study of them, will, in all cases, show to which species each belongs. Strophia, to be understood, requires careful study and attention, more so than most genera of shells, but when once mastered, certain characters that before seemed obscure, now become perfectly clear.

In making the foregoing remarks, I have frankly and freely stated the conclusions to which I have come, after a long, and most careful consideration of the subject, my sole object being the advancement of our knowledge of the genus Strophia. If I differ in opinion from some authors whose descriptions I have considered too general, it is not because I do not appreciate their labors. but rather because I take a different view of the matter from what they then took. I thoroughly believe that the time has come when the utmost minuteness of detail has become necessary in defining groups in nature, of whatever grade, but more especially is such minuteness of description needful in working out the details of specific and subspecific characters.

It must be constantly borne in mind that we of today are working as much. if not more. for the benefit of the coming generations as for that of the present. He who is a student of evolution must admit constant change. and to him it becomes most obvious that too careful attention cannot be given to minute differences in recording the present condition of the species or subspecies in hand. as thus. and only thus, can our work be available in the future to those who wish to mark the steps of change.

I do not intend to be understood that I would for a moment think of recording differences in Strophia which are not constant and of sufficient specific impertance to warrent so doing, and I am sure that I have not done so, as I feel confident that no one who will give the matter the careful attention that it merits, will disagree with me.

Strophia dallii may be known by the numerous striations—more than in any other described species—the cylindrical form, and channeled tooth. I have dedicated this species to the accomplished naturalists, Dr. William H. Dall, curator of mollusks at the Smithsonian Institute, Washington, D. C., as a slight testimonial of my appreciation of the value of his scientific researches.

Among the channeled toothed Strophias should be included the previously described S. ianthina and S. pallida.

DISTRIBUTION AND HABITS.

The first specimen of Dall's Strophia that I ever saw, I found in my Bahama collection of shells, but unfortunately labelled so that it was uncertain whether it came from Inagua or not. Later I found a few of this species in the collection of Mr. James A. Southwick, but again I was unfortunate in not getting the locality. It was only upon receiving a series of the Smithsonian Strophias, kindly forwarded to me by Dr. Dall, that I found the species labelled as coming from Inagua.

(CONTINUED.)

THE ARROW-HEADED WARBLER, OF JAMAICA.

DENDROICA PHARETRA.

The arrow-headed warbler, Dendroica pharetra. which is figured on Plate IX,was described by Philip L. Gosse, in 1847 in his "Birds of Jamaica", page 163. This representative of the large family of American warblers, confined as it is in habitat to the island of Jamaica. appears to be quite rare in collections. It does not seem to be very common even on its native island, and Mr. Gosse met with but one specimen, which he captured on the top of Bluefields Peak, on the 9th of February. He observed nothing characteristic in the habits of this individual. My own experience with the living species is limited to seeing two on a steep mountain side, near Kingston They were searching for food among the low branches of the surrounding woodland, in the manner of their kindred, and after giving me a moment's opportunity to observe them, they disappeared in the intricacies of the luxuriant foliage, while I pursued my way upward: so we parted, none of us worse off for the encounter. I heard no song, nor did I ever see a description of it. In fact, I believe that the complete history of these denizens of one of the fairest islands that the sun ever shown upon, remains to be written.

THE NICTITATING MEMBRANE AND CRYSTALLINE LENS IN THE MOTTLED OWL.

In the mottled owl Megascops asio. the nictitating membrane. or third eyelid, is exceedingly well developed, most admirably illustrating the method of opening it. The accompanying cuts are a little smaller than life.

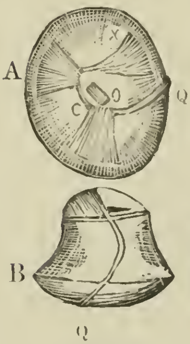


FIG. 34.

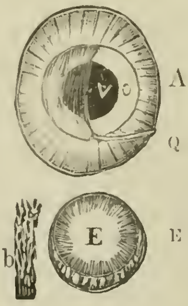


FIG. 35.

Fig. 35, A. shows the nictitating membrane partly covering the pupil v. and iris, o. It is drawn over the eye by a muscle attached to the lower corner, see Fig 35. A. q, passing down the side, Fig. 34, B. q. over the convexity of the lower surface, ib. A. q. around the optic nerve, c, to terminate in the flat, triangular, contractile body, ib. A. x. In passing around the optic nerve, the muscle is kept from pressing against it by one of the neatest arrangements seen in avian anatomy. There are two flat muscles at the back of the eye, attached outwardly, but with the inner ends free and formed into loops, through which the ligament of the muscle runs as through pulleys, see ib., c. The nictitating membrane is opened by its own elasticity. Its function is to guard the eye when the bird is dashing through foliage: it being translucent, objects can be distinguished through it with distinctness enough to be avoided. While feeding, however, the eyes are protected from the feathers or hair of their victims by closing the outer lids at least this is the case with the mottled owl, and in fact, with all of the other species of owls that I have kept in confinement.

In experimenting with the crystalline lens of the mottled owl, I observed that upon removing the back portion of the eye carefully and then placing a piece of printed paper as nearly as possible in the former position of the retina, looking into the eye through the lens, this and the humors remaining in position, the eye being thus about ten inches from my face, at that distance the letters behind it were enlarged about four diameters. The difference between the E in the lens, Fig. 35, and the E to the right of it, shows this difference almost exactly Without, perhaps, being absolutely conclusive evidence that the eyes of owls magnify, this would indicate that they did. At Fig 35, b. is represented a small section, greatly enlarged, of the ciliary process that surrounds the crystalline lens.

NOTES ON THE MAROON BUTTERFLY,
DANAIS BERENICE

Plate X; Fig. 1, male, lower side; Fig. 2, female, upper side.

The following is a description of the maroon butterfly, based on specimens taken in Orange County, Florida, in October, and these I have also figured.

DESCRIPTION.

Male. Above, nearly uniform maroon or yellowish chestnut, darkest at the base of the wings, and lightest on the inner margins of the secondaries. The entire wings are bordered with black, excepting the basal half of the upper margin of the primaries, most broadly on the outer margins of the secondaries, and narrowly on the inner; the margin on the primaries is about one half as wide as that of the secondaries. There is a line of about ten white dots within the black border on the primaries, two to each cell, excepting the lower which has two fused together, forming a larger spot. Within this, on the line of demarkation, between the brown and black, is another line of larger dots which does not extend into the lowest cell. In addition to this, there are two quite small dots on the central portion of the upper margin and in the central cell are two larger. Below these spots, on the outer border of the cell, is a rather suffused dark brown spot.

On the secondaries, there are about four white spots in the black border of the upper margin, and all along the outer border of both wings are minute white spots, two to each cell. The veination above is not prominent.

Beneath, the colors seen above on the primaries are repeated, but the white spots are larger, and there are two in the next to the lowest cell, where they are absent above.

The secondaries have a double line of white spots in the black border; the veins are lined with black, and these lines are narrowly margined with white, and there are four white dots in the center of the wings. In the cell below the central, above, is a large oval, elevated spot, which below encloses a white dot; a generic character.

Eyes, feet, antennæ, head, and thorax, black, the two last dotted with white above and below. Abdomen, maroon, lined with black and white below.

Female. Similar to the male, but with the white spottings smaller and less numerous, and the elevated oval spot is absent.

DIMENSIONS.

Extent of wings, 2.75. Size of primaries, 1.60 x 1.05. Size of secondaries, 1.20 x 1.00. Length of body and head, 1.00. Antennæ, .60.

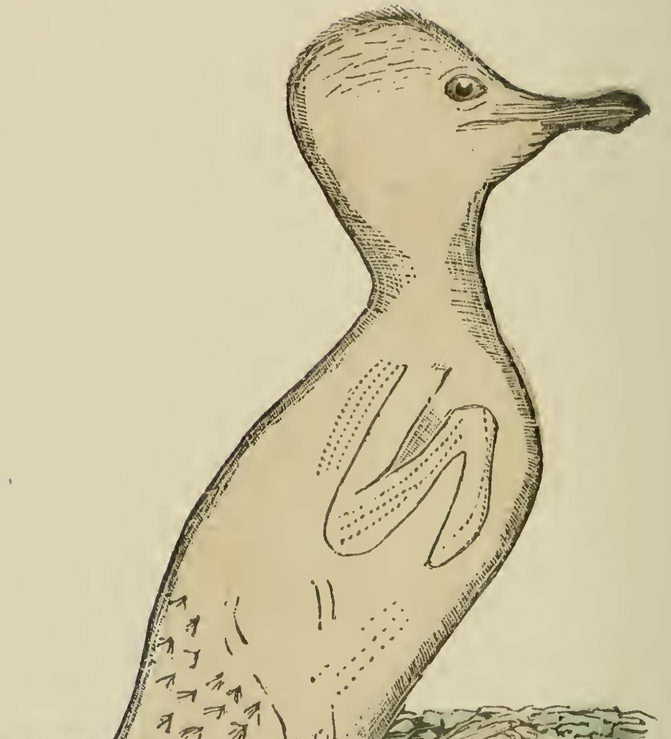
OBSERVATIONS.

This species may be at once distinguished from all other North American butterflies, by the uniform maroon color above, without prominent dark lines or spots above, excepting on the border. Distributed throughout the extreme Southern States.

HABITS.

My first experience with the maroon butterfly, was during a voyage that I made from Boston to Savanah, many years ago. When the

PLATE XII.



EXPLANATION OF FIGURE ON PLATE XII.

Sula bassana Linn., Common Gannet, young, about two days old, taken on Bird Rock, Gulf of St. Lawrence, the first week in July, 1873. Life size; drawing made from a skin.

CONTRIBUTIONS TO SCIENCE, VOL. I.

steamer had passed Cape Hatteras, and was headed toward land, but still some fifty miles at sea, clouds of three or four species of butterflies, among which were a goodly number of Danais berenice, came from the land. They were flying at a moderate elevation above the water, and many struck the sails, falling upon deck. There was a gentle westerly wind blowing. This was during the first week in November, and there must have been an unusually late brood for so far north.

I have found the maroon butterflies very common, and fresh, two seasons at Rosewood, Florida, the first week in November, but they were not at all common in central Florida another year, during this time, and all had disappeared from this section by the twentieth of this month, On Key West they were very abundant during the second and third weeks in November, but upon the appearance of a cold storm, all suddenly disappeared.

It is rather singular, taking into consideration the migratory habits of this species, that it does not occur on the Bahamas and other of the West Indies. I have searched for it in vain and neither it, nor any representative of it, is found, yet the milk-weed butterfly, D. archippus, is common.

The maroon butterfly is a rather sluggish species, moving quite slowly, keeping low down near the ground. In very bright, warm weather it is more active, flitting from flower to flower with comparative rapidity. It is a persistent feeder, resembling in this particular its closely allied relative, the milk-weed butterfly, and when engaged in sipping the sweets from flowers it is so utterly oblivious to all else that it may be easily captured.

These butterflies are very tenacious of life, yet rather singularly appear to weaken at once when the weather becomes even a little cold or stormy. The coolness of night affects them, and they become inactive, even before sundown. They have a habit, in common with some other species, of gathering in numbers to roost at night. On the island of Key West, they and other butterflies, selected bushes along the shore as resting places, Towards night the butterflies began to congregate, coming in from all quarters, and alighting beneath the leaves, would hang wings down, numbers often close together, so that scores frequently occupied the space of a few square inches. The silver wing, Agraulis vanillæ, a Pieris, and some other species accompanied them; these were easily disturbed, even after sunset, but at that time the maroon butterflies could be taken off in the fingers, apparently perfectly helpless. As remarked, when at rest at night the wings are folded, and they are also closed when the insect is feeding, thus rendering it in a great measure, inconspicuous.

NOTES ON THE YOUNG OF CERTAIN SPECIES OF BIRDS.

The following notes are based upon my observations on the young of certain species of birds, with especial reference to those of some of the water birds, while among these the totopalmates have been especially studied. Nothing like completeness of anatomical structure has been attempted, nor is the history of any one species finished. As will be seen, the notes made are merely comparative, but such as they are, I trust that they will prove useful in elucidating a subject that has been too much neglected.

TACHYPETES AQUILA.

Man-of-war Bird.

Plate XIV, young, about two days old, taken on Little Cayman, April 20, 1888. Life size; drawing made from a recent specimen.

It was with great interest that I looked for the young of this magnificent bird, and upon my visit to Little Cayman, this desire was gratified, so far as finding all stages of growth, from the specimen that I have figured up to fledgelings in which the wing and tail feathers had begun to grow.

In the extreme young the disproportionate size of the various organs in comparison with those of the adult, are most striking, in fact nothing is similar, and were it not for the webbing connecting the posterior with the anterior toes, it would be difficult to conjecture that it was a member of this order.

The eyes are extremely large, occupying nearly or quite one half of the skull, but at the same time the orifice is small and closed at this age. The beak is short, being only about as long as the skull, not very much longer, as in the adult, and there is only an indication of the powerful hook at the extremity, seen in the adult. (For comparison with life size head of adult, see Plate XV.) But one of the most interesting features, is the large size of the gular sac, proportionately as well developed as in the pelicans, and thus indicating the well pouched beak of its remote ancestors: in this connection, see article on the Probable Evolution of the Totopalmates, where the adult is given as having a rather minimum development of the gular sac among members of the order.

The limbs are remarkable; in the wings, the humerus and forearm are about equal in length, instead of the latter named greatly exceeding the former, thus the wings are proportionately very small. On the other hand, the legs are extremely large, especially when compared with the wings. The forearm and tibia are about equal in length, instead of the latter named being about five times as long as the former, as in the adult, while the feet are about one half as large as they will ever be. Thus the leg and wing are now equal. The body is proportionately much larger than in the adult. In short, now, the bird is constructed in every way for clinging to the sticks of its nest, or to the branches of trees, which a little later in life. it can do most tenaciously. Who, to look at this helpless, poorly proportioned chick would imagine it to be the young of such superb parents? Who would for a moment conjecture that those weak, short wings, the muscles of which are now so slight that the bird can scarcely fold them, will develop into the most powerful pinions possessed by any species of bird, and bear their owners over the trackless ocean in absolutely untiring flight.

Upon comparing the young of the man-of-war with that of another short-legged bird, but of a very different order; viz: the belted kingfisher, a bird which is not obliged to cling to its nest or to branches when very young, we find that although the foot and leg of the kingfisher is proportionately larger than in the adult, it is not as greatly disproportionate as in the young man-of-war, and also has a swollen functionless appearance. (See Fig. 36, where is given a cut of a nearly hatched young of the belted kingfisher, Ceryle alcyon, twice life size.)

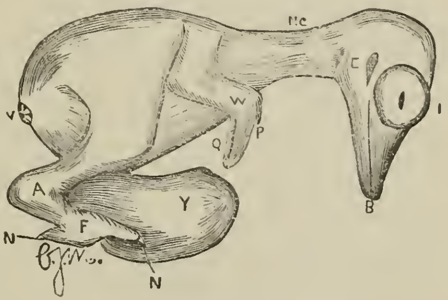


FIG. 36.

At first the young of the man-of-war is practically naked, but when some ten days old the entire bird is covered with a thick. white down, and simultaneously the dark brown scapular and interscapular feathers appear. These form a striking contrast with the pure white down, and the birds as they sit upright on their tarsi look as if they were clad in cloaks.

When four weeks old the dark wing quills and tail feathers begin to bud, but do not attain any considerable length until the birds are two months old.

When a month old the feet have attained very nearly the size of those of the adult, but the toe nails are not as long, and that of the middle toe is not yet notched on the inside, (see Fig. 37, where I have given a life size figure of the foot of the adult.) The proportion of the wings has greatly changed. The forearm is considerably elongated. being now twice as long as the tibia. but again, the hand (carpus. metacarpus, and phalanges) has not kept equal pace with it. and in place of being nearly as long as the forearm, as in the young, it is only about one half as long. In the adult, the hand is about three fourths as long as the forearm Thus in the young, the proportions of the forearm and hand are more nearly like those of the adult than in the intermediate stages.

The extreme young Tachypetes are not as helpless as those of the gannets, but later when nearly fully grown, though not fully fledged. they do not even leave their nests, while at this age the young gannets are wandering all over the trees on which their homes are situated.

The young man-of-wars are not as fearless as are the gannets, but one that I carried to my house, readily became tame and exhibited considerable intelligence. It was a much more voracious feeder than the gannets, and much more noisy. At such times its notes resembled those of young herons. but when frightened the young man-of-wars emit a curious stuttering cry, which strongly appeals to one's sympathy for it reminds one most strikingly of the efforts of an uneducated dumb child to articulate. I have said elsewhere that the young of Cory's gannet has a tremulous motion of the head, at times, similar to that exhibited by the pelicans and anhingas, yet I saw nothing of the kind in my man-of-war, and I kept it nearly two months. On the other hand, while the gannets were quite inclined to hold their beaks well up. the man-of-wars held theirs down against their breasts, after the manner of the pelicans.

Although not absolutely assured of the fact, I have reasons for believing that the adult man-of-wars feed their newly hatched young by regurgitating a similar glairy fluid that the gannets use, and they care for their offspring most tenderly, yet do not cover them so persistently as do the gannets.

SULA CORYI.

Cory's Gannet.

Plate XI, young, about two days old, taken on Little Cayman. April 24, 1888. Life size; drawing made from a recent specimen.

Although the proportions of the limbs of the extreme young of Cory's gannet are not strikingly different from those of the man of-war, yet they are not, on account of greater symmetry of parts in the adult.

as disproportionate when compared with those of the parent. The forearm is longer than the tibia, and the hand about two-thirds as long as the forearm. The bill, although a little stouter proportionately than that of the adult, is of the same relative length when compared with the head. In short, all the proportions are not greatly different from those of the adults, or, at least, not any more so than is usual with the young of most species of birds.

I have already given the various stages through which this species passes in assuming the adult dress and size under description of Cory's gannet, page 40.

In comparing the young of Cory's gannet with that of the man-of-war we note first, the absence of disproportion in the organs; second, the comparatively small size; third, the form of the body. The gannet has a body more like those of young birds in general,—compare with that of the kingfisher, Fig. 36—while the great prominence of the muscles of the breast of the man-of-war, so noticable in adult, is manifest at the early age figured, in fact, as shown, disproportionately manifest.

In the matter of clothing, the gannet is in advance of the man-of-war, so far as a covering of down is concerned, it having some when hatched, and is fully covered in about five days. The man-of-war remains comparatively naked much longer, but acquires some feathers long before the gannet shows a trace of them. The first feathers to appear on the gannet are those of the wing and tail, and these have attained a considerable length before any feathers on the back are seen. Then the scapularies grow out, but not the interscapularies, which are among the last feathers to appear. I have shown elsewhere in this volume, that the fully fledged Cory's gannet exhibit a great reluctance to to make the first effort to fly, but much to my regret, I found no specimens of the young man-of-war that were old enough to fly at all; none of them being fully fledged.

SULA BASSANA.

Common Gannet.

Plate XII, young, about two days old, taken on Bird Rock, Gulf of St. Lawrence, the first week in July, 1873. Life size; drawing made from a skin.

In comparing the young of the common gannet with that of Cory's gannet, of the same age, we find that the bill is of a different form, the wings, although of a larger bird, are absolutely smaller, and that the feet are large, compared with the wings. In spite of the fact that this species is an inhabitant of a cold region, where the young of Cory's gannet, with its delicate constitution, could not exist at all, this little common gannet is practically destitute of down: this being represented by a few scattering tufts on the lower portion of the back and along the scapularies. I have shown the vast difference between the young, of the same age, of these two species in vigor. What better illustration could we have of the care that nature exercises over her offsprings than this? Operating through her mysterious laws, she hastens to supply the debilitated gannet under the burning sun of the tropics with a warm covering of down, while the more hardy gannet of the boreal clime must endure the cold, simply because it can do so without absolutely perishing. In the north, a survival of the fittest has produced a hardy, long-enduring species, by simply withholding clothing at a critical period of the bird's life; thus allowing the weaklings to perish that the species may survive. In the south, an opposite law has attained a similar result; species have been evolved and perpetuated by the weakening of offsprings, and consequently of adults. This physical weakness has, in a great measure, incapacitated them for long flights, thus when by any chance one, or more, pairs become blown to an island, moderately remote from their original home, their lack of strength will then govern their inclination, and they will remain where they chanced to alight, the nucleus of a new colony. Thus no one locality is over crowded, and all can obtain a supply of food.

The form of the body in the plate of the young of the common gannet, although approximately correct, cannot be implicitly relied upon, as the drawing was made from a dried skin a number of years ago.

PUFFINUS AUDUBONI.

Audubon's Shearwater.

Fig. 36*, young, one day old, taken on Green Key, Bahamas, April 5, 1884. Life size; drawing made from skin.

With the totopalmates, the young are probably all hatched naked, or nearly so, but with the group, of which the present species is a representative, the fulmars, shearwaters, petrels, etc. as far as known, the reverse is the case, and they are all exceedingly well clothed with down upon leaving the egg.

The young Audubon's shearwater of which I have given a drawing was the outcome of an egg that I collected on Green Key, and which hatched the next day, in ordinary temperature, of the air, that at night fell as low as 70 degrees. The young bird lived only twenty-four hours.

The proportions of the various organs in the young of this shearwater are almost exactly similar to those of the parents, and so continue until the birds are fully grown, thus differing from many water birds, especially from the gulls and terns, as shown in the following article on the least tern

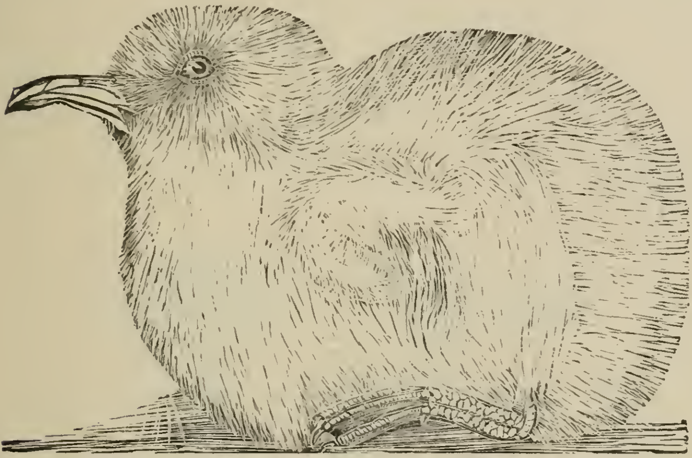


FIG. 36^{a}. Young of Audubon's Shearwater, one day old.

The young of this shearwater, even after they have attained considerable size are strangly susceptible to heat, and an exposure of only a few minutes to the vertical rays of the sun is certain death to them; on the other hand, they will endure considerable cold, even when very young, without injury. Here again we see the tendency exhibited to produce a hardy race, where hardihood has become a necessity of life. The young early become inured to even a colder degree of temperature than that of the atmosphere, for they are, when only two or three days old, left by their parents to shift for themselves in damp, drafty burrows, their food only being supplied, and that at long intervals. Their great susceptibility to heat prevents degeneration, and thus the requisite vigor of the species, to meet the exigencies of its wandering life, is maintained.

The young Audubon's shearwaters are as large as the adults before they begin to acquire feathers, and the first to make their appearence are those of the wings and tail. I have never had an opportunity of tracing them to the completed plumage, thus can say nothing about the manner in which the other feathers appear.

The young birds that I have taken living have readily become tame, but I have never succeeded in keeping any one individual over two weeks, it being evident that I was unable to supply them with proper food, they died. The notes of the immature shearwaters, resemble those of young turkeys.

STERNA ANTILLARUM.

Least Tern.

Fig. 36**, n, life size head of young, one day old, taken at Ipswich, Mass., July, 6. 1868. Y, greatly enlarged bill of young; A, life size bill of adult.

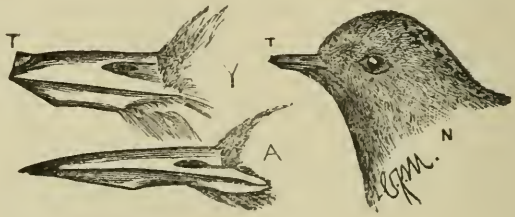


Fig. 36**.

The great gull family, of which the least tern is the smallest member, is another group in which the young are, as far as known, hatched covered with down.

The proportions of the various parts of the least tern are quite different from those of the adult. The bill is proportionately very much shorter and stouter, and of quite a different form, as seen in the cut In the specimen figured, the egg tooth, T, T, is quite a prominent feature.

The wings are proportionately short but the legs are very large, and before the birds have attained one third of their growth they have become as large as they will ever be. This is a provision to enable the young terns to make their way over the ground with ease, and thus not only avoid being buried under the shifting sands, during high winds, but also escape whenever a high tide unexpectedly covers the breeding ground. Thus the first few weeks of the lives of the young terns are passed in a similar manner to those of sandpipers, and they can run as nimbly as can these active birds.

The first feathers to make their appearance on the young terns are the wing quills, followed by those of the tail, but before these last mentioned are half grown, the birds have acquired sufficient strength of wing to fly some, and before the body and head are entirely out of the down, they can take quite extended flights.

Thus the young gannets which are in comparative safety in trees, are fully fledged before it enters their heads to attempt to use their wings, while the young terns which are in danger from many enemies while they remain on the ground, as soon as they feel the weight of the growing quills, stretch their wings and endeavor to rise into the air.

(CONTINUED.)

PUBLICATIONS RECEIVED.

SECOND SUPPLEMENT TO THE LIST OF COLEOPTERA OF AMERICA, NORTH OF MEXICO, BY SAMUEL HENSHAW. Brooklyn Entomological Society; July, 1889.

In this Second Supplement to his valuable List of North American Coleoptera, Mr. Henshaw has given a list of the species which have been described since the appearance of the First Supplement in 1877. The Bibliographical references are continued.

ON ANGELOPSIS AND ITS RELATIONSHIP TO CERTAIN SIPHONOPHORA TAKEN BY THE "CHALLENGER", BY J. WALTER FEWKES. Authors extra, from the Annals and Magazine of Natural History for August, 1889.

Dr. Fewkes here gives a more detailed description of this singular genus of medusæ described by him in 1884. In speaking of its peculiarites, he says; "This genus is remarkable for its large float and the reduction in size and increase in thickness of the walls of the polypstem, which has the form of a semicartilaginous expansion with a cavity, and with its external walls covered with the polypites, sexual bells, and possible tentacles. It is also remarkable in possessing bud-like structures on the lower part of the float, near its junction with the base." Angelopsis is carefully compared with other allied genera. and the differences in structure noted. The paper is illustrated by a plate.

NORTH AMERICAN FAUNA. Under the accompanying title, the United States Department of Agriculture, Division of Ornithology and Mammalogy purposes publishing a series of papers appertaining to the animals of our country.

No. 1 of this series. issued October 25, 1889, is occupied by a paper on the Revision of the North American Pocket Mice, by C. Hart Merriam.

Dr. Merriam has given genus Perognathus a very thorough and timely revision, with most unexpected results, for twelve species have been described as new and three subspecies, while the nomenclature of the old species has been changed somewhat. A key to the known forms, and four clearly drawn plates, illustrating specific and generic characters accompany the paper.

No. 2 of this series, published October 30, 1889, contains papers, all by Dr. Merriam, in which fourteen new species of North American Mammals, and one new genus are described.

The following is a brief notice of the species. subspecies, and genus described in this series of valuable papers, all of which bear marks of great care in their preparation. Two new species and one subspecies of grasshopper mouse, Onychomys, with a synopsis of this genus: a new marmot. Arctomys: a new pika. Lagomys: two new spermophile, Spermophilus; two new ground squirrels. Tamias; two new free-tailed, bats, Nyctinomus: a new genus of mice, Phenacomys, allied to Arvicola; this new genus being introduced by four new species. The papers are accompanied by eight plates, six of which illustrate most clearly the characters which the author wishes to portray; less satisfactory. however, are the two plates made from photographs. as much detail is lost in shadows that will come where they are not wanted, in this class of illustrations.

The Department of Agriculture also issues circular by Dr. Merriam, containing brief directions for the measurememts of small mammals and the preparation of museum skins. which will prove exceedingly serviceable to collectors,

---

PROF. HENRY A. WARD is writing a series of exceedingly interesting articles for the Rochester, N. Y., Democrat and Chronicle, on his travels and sojourns among the Patagonians, Fuegians, and other citizens of the extreme austral tip of the great Continent of South America. Prof. Ward's description of the scenes through which he has been passing, are extremely graphic, and one reads his stories of these strange, scarcely human, people with intense interest.

MR. J. I. DAVIDSON has issued a List of the Birds of Niagara Co. N. Y., with annotations. Reprinted from Forest and Stream, September 1889. This is a list of one hundred and ninety species, with many interesting notes, especially those on the black-billed cuckoo, one of which is described as depositing its eggs in a robin's nest in which a Carolina dove had also laid her two eggs.

NOTES AND CRITICISMS.

It is with the deepest regret that I announce the death of my faithful dog Spot. To those who did not know her, I will say that Spot was a handsome, black, white, and tan setter of mixed Laverack and Gordon blood. She was remarkably intelligent, even for a dog of this class. She had been twice to Florida with me and once to the Bahamas, and I have many times had occasion to record various acts of hers, in which her ready comprehension of what was required of her, has materially aided me in securing the objects for which I was in search. Her universal good nature and keen appreciation of sport, had won for her many friends, from the creole sailors on my vessels in the Bahamas to the scientists who came to see her master. By her death, Science loses a valuable assistant, and her master a faithful friend.

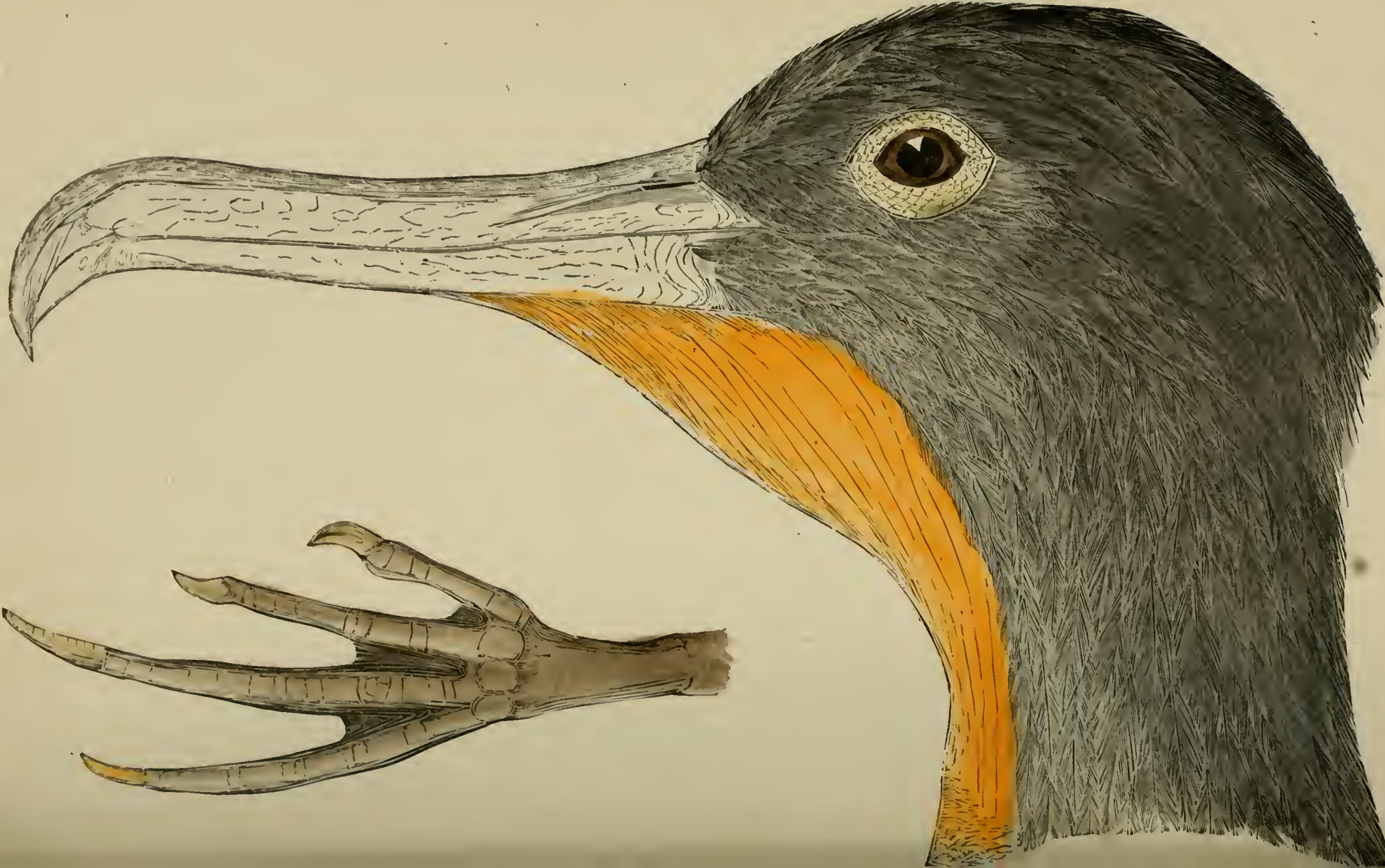
The unusually mild autumn appeared to have considerable influence upon the birds; late in October I heard the daily song of a song sparrow, the notes being given as distinctly and clearly as in spring. Many more migrating species of birds uttered songs that I have never observed before, more especially the warblers.

Mr. Wm. H. Fisher, of Baltimore. Maryland, writes me that he found the nest and four eggs of a song sparrow on August 13, an unprecedentedly late date, especially for so far south.

Mr. Fisher also sent me the wings and tail of Baird's sandpiper, shot in Baltimore on September seventh.

Beyond all doubt, that mysterious disease, hydrophobia, is greatly to be dreaded and too much caution cannot be used to guard against it. We can therefore scarcely condemn the zeal of policemen and others in authority, in destroying dogs that are apparently affected with the dread disease, or others that have been bitten by dogs that were supposed to be mad. On the other hand, those who own valuable dogs will often object to having them killed upon what may be, after all, mere supposition. For herein lies the evil of the present system for guarding against hydrophobia, no one who is perfectly competent to judge whether the dog suspected has the disease or not, is present in the majority of cases, to decide the matter beyond dispute. There certainly should be some such person, one thoroughly posted upon the subject, appointed by city and town governments to act upon matters pertaining to madness in dogs, examining, if necessary, the bodies of suspected dogs that have been killed. Thus will not only the lives of valuable dogs be often saved, but much needless anxiety be spared to over nervous people; and above all, reliable data be obtained of the number of instances of the occurrence of hydrophobia in our midst.

PLATE XV.



CONTRIBUTIONS TO SCIENCE.

BY

CHARLES J. MAYNARD.

Vol. I. January, 1889. /5? No. 4.

NOTES ON THE ANATOMICAL STRUCTURE OF THREE SPECIES OF GANNETS.

(CONTINUED FROM PAGE 123.)

The following notes are from a recent dissection of a specimen of the Common Gannet, Sula bassana.

The oesophagus is dilated to a great degree: it is 19.00 long: there are prominent folds of the mucous membrane, running longitudinally the entire length of the interior, and these merge into the wide proventriculus, without any constriction.

The proventricus, Fig. 37, a, is wide, measuring 1.50 in diameter, and is about 4.00 long, with the glands of the secreting surface arranged in a peculiar manner, these being divided into two sections, both rather triangular in form, the upper large, 3.50 by 2.00, and the lower, smaller, and proportionately narrower, about 3.00 by 1.00. See Fig. 39, a, being a diagram of the upper, and c, of the lower, cluster of glands, about one fourth the size of life. The glands are simple and cylindrical in form, ib. d, where is given a life size cut of a cluster.

The stomach, Fig. 38 a, is continued from proventriculus without any construction, but it becomes narrower, a little back of the junction. It is a mere sac, 2.00 long by 1.00 wide: the walls are thin, and it is lined with a soft, mucous membrane, much wrinkled. Near the pyloric opening, these wrinkles become enlarged into folds, two of which overlie the orifice, see Fig. 36, a, being the opening, and b, b, the folds which overlie it. The intestine is provided with a sphincter muscle, just within the entrance, by which the orifice may be completely closed.

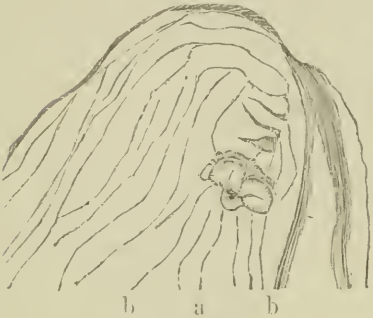


FIG. 36.

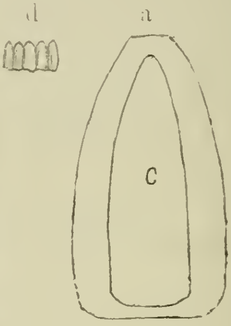


FIG. 39.

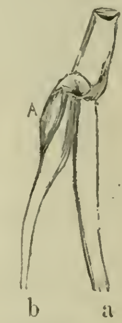


Fig. 38.

The intestine emerges from the stomach, about one half the length, Fig. 37, thus the terminal portion becomes a cul-de-sac, ib. b. The intestine pushes outward for about 1.00, then turns upward for 1.75, then downward for 4.75 then once more upward to form the fold of the duodenum.

The pancreas ib. d, is 4.75 in length, long enough to reach the entire length of the fold, but as it begins about 2.90 from its termination, it extends some distance along the intestine.

The intestines are 64.00 long, and are not large in diameter, measuring only about .50. The cœca, Fig. 37, c, are very small, but the blind ends are detached from the intestine and are pointed. One is larger than the other.

The spleen is a pyramidical-shaped body, lying between the intestine and the anterior portion of the proventriculus.

On the left carotid artery of this specimen is a small thyroid gland of a rather peculiar structure, inasmuch as it appears to be double, there being an inner elongated portion, pinkish in color, and an outer, elliptical body lying on this, which is whitish or yellowish. See Fig. 38, a is the artery, b, the elongated gland, A, the outer elliptical.

This particular gannet was evidently an aged specimen. It being a female, with the ovaries nearly depleted there being about a hundred and forty ruptured capsules, among which are interspereed a comparitively few ovules. As a ruptured capsule indicates most surely that an egg has been deposited, it is reasonable to suppose that this gannet has laid something like one hundred and forty eggs and, as there is but one egg normally laid in a season, this would give an approximate great age to the bird, even if we allow for occasional accident to an egg, when a second specimen would be deposited that season.

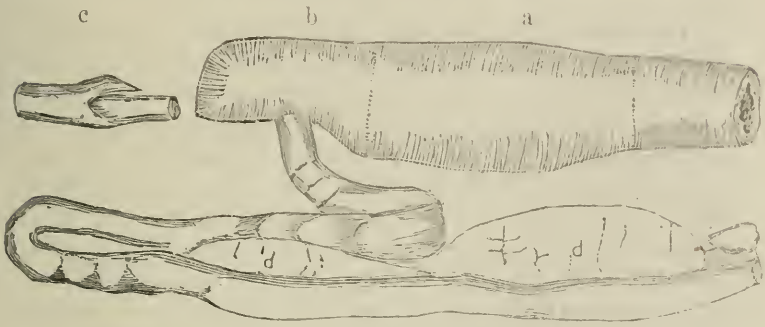


Fig. 37.

SUMMARY.

We find in comparing the organs of the species of Gannets under our consideration, that the tongue and superior larynx of the Common Gannet differs greatly from those of Cory's, there being very little, or no resemblance between the two species in these respects.

The inferior larynx of the Common Gannet is also very unlike that of both Cory's, and the Booby Gannets, as it not only differs in form, but also possesses the thymas appendage, not a trace of which is found in the other two. The tympaniforms are also different. On the other hand, the inferior larynx of Cory's Gannet is not unlike that of the Booby differing from it only in comparatively minute particulars.

Of the organs described, it is only when we come to the digestive apparatus, that we find a general resemblance among the three species. Even here, however, the Common Gannet differs somewhat from the other two in having the glands of the proventriculus not arranged in longitudinal ridges, but in two triangular tracts. We have seen in a former paper on the evolution of the totipalmates that the Common Gannet had apparently assumed more fixed characters than those of the other two, and this fact is emphasized by the foregoing observations.

NOTES ON WEST INDIAN REPTILES AND BATRACHIANS.

(CONTINUED FROM PAGE 115.)

CYCLURA NUBILA GRAY.

CLOUDED IGUANA.

On the east end of the Island of Cayman Brac, are cliffs that rise abruptly from the sea to the height of eighty feet. This elevation forms a table land, skirted on both north and south by a low coast, but to the westward, the land slopes gradually, until at the extremity of the island it terminates in a low beach. On this elevated portion, especially to the eastward, are quite deep deposits of soil, and these under a tropical sun, support a most luxuriant growth of vegetation. This mainly consists of forest trees which rise to a considerable height, and which grow quite to the edge of the abrupt cliffs. In fact, many of the trees cling to crevaces directly on the face of the cliffs. This is more particularly the case with a singular species of tree, known as the balsam. This tree has light colored, or nearly white, trunk and branches, and large, rather thick and tough, dark green, glossy leaves. Wherever these trees are found, the clouded iguana also lives, and, as I have elsewhere mentioned, appears to feed exclusively upon the leaves.

These iguanas are very shy, seldom being seen in the daytime, evidently being nocturnal in habit. This may be due to the fact, that they are constantly hunted for food by the inhabitants, dogs being trained for this purpose, to run among the rocks, and chase the reptiles into the trees, or into some crevice of the cliffs, where the hunter can reach them. The deeper caves, in which the cliffs abound, appear to furnish them with permanent and safe abodes.

Although, according to the inhabitants, this iguana is still quite common on Cayman Brac, the stronghold of the species is on the island of Little Cayman. Here at the eastern end of the key are also cliffs but they are much lower than at Cayman Brac, while the table-land is composed of rocks, worn through aqueous and atmospheric action, into jagged points, over which it is almost impossible to make one's way, and which support little or no vegetation. The balsam occurs, however, growing in a dwarfed form. I say that this island is the stronghold of the species, and in making this statement, I am guided, partly, by the reports of my boat-men, but more particularly, by my own observations of the numerous tracks in the sand of the beaches, especially on the north side, near the eastern end. I actually saw only a single specimen, that I came across as I was making my way along the edge of the cliff, directly at the east end of the island. The iguana was carefully picking its way among the rough points of the rocky surface, moving from necessity very slowly, as such was the character of the surface, that any degree of speed was impossible. I easily shot it, and upon taking it to a small fishing camp, to which I was bound, skinned and dissected it. This specimen, which was only about three feet long, proved a female with eight eggs in the oviducts. These eggs were still without shells, and were about an inch in diameter.

A male, of which I have given an account on page 37 of this Bulletin, measured about five feet in length. In walking on a level surface this large lizard drags its tail quite heavily, leaving a very conspicuous furrow in the sand, thus its trail quite closely resembles that of an alligator. I heard no note from the specimen I saw, nor could I learn that any sound was produced by them. It would appear from the small number of eggs that I found in the oviducts of the specimen I dissected, that they were not very prolific. I did not observe the tracks of any small individuals, and it is probable that the rapid increase of the species is now checked in a great measure, by the feral cats that are abundant there. I also learned that a species of ichneumon, known as the mongous, (Herpestes mungos) which has been introduced into Jamaica, within the last few years, for the purpose of exterminating the rats in the cane fields, has also made its way to Little Cayman. If this be true, it is probable that this prolific, and rapidly increasing, mammal will speedily exterminate, not only this lizard, but also every living thing on the key, upon which it can prey. In Jamaica the mongous has become a perfect scourge, for it has increased with such rapidity, that it is almost impossible to raise any domestic animal which they can destroy. They are so abundant that it is impossible to walk, even in the suburbs of Kingston or of Spanish Town, without seeing specimens of the mongous. The clouded iguana is slightly brown in color, marked with darker in clouded patches.

DIPLOGLOSSUS MACULATUS Garman.

Spotted Skink

When on Cayman Brac, I learned of a kind of lizard, that was called a "wass" and was said to live under the piles of cocoanut husks, and was also said to be poisonous. It must be far from common, as

I threw over, piece by piece, several piles of cocoanut husks without finding a single specimen, and it was only when I was about to give up in despair of ever seeing a "wass", that I succeeded in finding one. It moved with great rapidity, and was very difficult to capture. This specimen was pale brown, spotted and streaked longitudinally and transversely, with darker. Why this pretty little lizard is considered poisonous by the inhabitants, who according to their own account meet with it but seldom, I am unable to ascertain. When on Little Cayman, I saw another specimen, evidently of the same species, running about among the rough, weather-worn points of the rocks, on the so called "iron shore," near the water. It was so exceedingly nimble, and the surroundings presented so many hiding places for it, that I was unable to capture it.

CROCODILUS.

One species of crocodile occurs on Cayman Brac, and two on Little Cayman, where I saw a portion of one specimen. They inhabit swampy places in the interior, and I was informed by the natives, that they were of the same species as are found in Cuba. In fact, I was told that they had been seen to land from floating logs.

ALSOPHIS FUSCICAUDA Garman.

Brown-tailed Snake.

This small snake is exceedingly rare, and the specimen obtained was taken in the scrub. I saw a second specimen while searching for lizards beneath a pile of cocoanut husks.

DERMOCHELYS CORIACEA Merr.

Leather-back Turtle.

This large species of marine turtle, readily known by the prominant longitudinal ridges on the back, is occasionally found in the vicinity of the Cayman Islands. They are said to breed on the small, sandy keys of the Rosalind Banks, off the Mosquito Coast of South America. Although the leather-backed turtle breeds in the Tropics, it has a wide range, specimens having been taken in the Mediterranean Sea and off the coast of New England.

THALASSOCHELYS CAOUANA Fitz.

LOGGERHEAD TURTLE.

The most abundant of the marine turtles about the Caymans. They are captured by the natives for food, and for the oil. The shell also sells for a small sum (6 cts) per lb. The favorite fishing ground for these turtles is along the barrier reef, off the northern side of Little Cayman, but near the eastern end. Coarse meshed nets, some twenty-five feet long by about ten feet deep, are set at right angles with the reef, on the surface just outside the breakers. The turtles in swimming along the reef, in search of food, come in contact with the nets, and in endeavoring to push through them, become entangled.

In coasting down the the reef with my boatmen, we came across a net, in which three huge loggerheads were entangled. Upon our approach, they made frantic efforts to escape, frequently emitting air from their mouths with a loud, hissing sound: blowing, my boatmen called it.

The flesh of the loggerhead is rather strong tasting, but not absolutely disagreeable, when one sits down to it with a keen appetite. The oil is used for culinary purposes, and is rather rank, but when perfectly fresh, answers very well for frying fish, but of course cannot compare with cocoanut oil that is so often used for this purpose in the West Indies. As remarked, the shell is sold probably for the manufacture of gelatine. It is cut up in pieces convenient for packing.

The loggerheads deposit their eggs on these islands in May. The third of this month, as I was walking along the beach on the south side of Little Cayman, I saw where a large female had crawled up in three different places, during the night. In neither of these, however, had she deposited any eggs, as, with the assistance of my boatmen, I ascertained by a careful examination of the sand, where the animal had paused to dig. In one place in her wanderings, for she crawled about fifty yards each time she came out of the water, she made what my man called "a half moon", that is, she described a half circle some ten feet in long diameter. I was informed that this was not unusual, but no reason was given for the performance. Turtles are said to visit the beach in the manner described, without depositing any eggs. They are said to be selecting a suitable location in which to lay.

I was told that about 125 eggs were deposited for a first litter, then in thirteen or fourteen days, another lot of the same number were deposited near the first, and a third laying of the same number were left after a similar lapse of time. Thus in about six weeks, this turtle deposits three hundred and seventy-five eggs.

The eggs hatch in twenty-eight days, and always in the night. The young at once take to the water and most singularly as I was informed by several experienced turtlers, are never seen in the vicinity of these islands until they have become nearly fully grown.

ERETMOCHELYS IMBRICATA Fitz.

Hawksbill Turtle.

The hawksbill occurs in considerable numbers, and they are caught in the same nets in which the loggerheads are captured. This species is not as often taken, however. The hawksbills breed on the islands, laying their eggs at the samet ime as do the loggerheads. The young though, are often captured about the islands, even when very small.

The turtlers of the Caymans speak of what they call a hybrid between the hawksbill and the loggerhead. These animals have the head of the loggerhead, and the shell of the hawksbill, and the scales are good or not, according as the offspring "take after the mother" (always supposed to be the loggerhead) when is is poor, or "take after the father" the hawksbill, when the shell can be used.

CHELONIA MIDAS Schw.

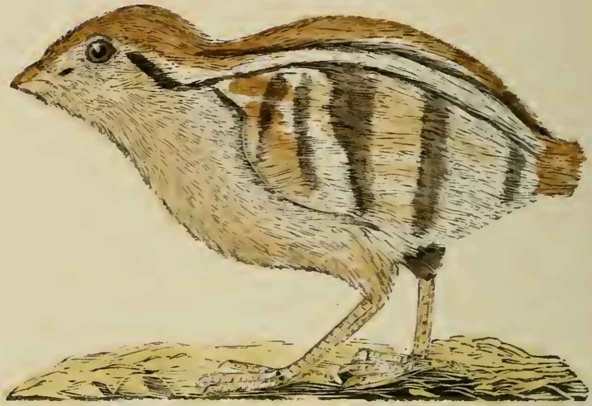
Green Turtle.

Rather more common about the Caymans than the last named species, and also breeds on the beaches, while the young are not infrequently seen. The green turtles are not abundant enough here, to furnish any great supply, most of the turtles of the species that are taken to the Kingston market being captured by the Cayman fishermen, on the Mosquito Coast of South America. Here, they are taken in nets, much as I have described in the article on the loggerhead.

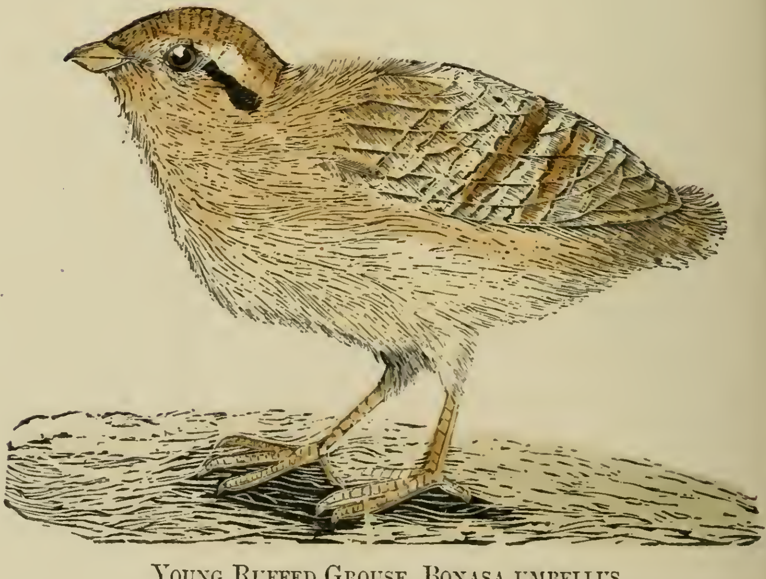
The price of green turtles, in the Kingston market, varies somewhat with the supply, but averages about $5.00 per head, for specimens that weigh one hundred and twenty pounds. Under this weight, to eighty pounds, three are counted as two; then turtles lighter than this, bring nine or ten cents per pound.

A species of land turtle has been introduced into Cayman Brac from Grand Cayman, but I did not succeed in procuring any specimens.

PLATE XIII.



YOUNG QUAIL, ORTYX VIRGINIANUS.



YOUNG RUFFED GROUSE, BONASA UMBELLUS.

HYLA SEPTENTRIONALIS Tsch., Blgr.

West Indian Tree Frog.

This widely distributed species, which I have found on all of the Bahamas which I have visited, excepting Inauga, is also common on Little Cayman, but never occurs on Cayman Brac. In fact, I was told that specimens taken there would not survive. These little frogs live in the air plants, as a rule, but I found a colony established in the buildings of the Phosphate Company on Little Cayman. During the daylight they remained perfectly silent, and hidden in crevices beneath the eaves, or in the buildings, but as soon as the sun had sunk into the waters of the Caribbean they began a concert that lasted till sunrise the next morning. The cries emitted by them are loud, consisting of two or three notes, and no two individuals sing alike; thus, the musical efforts of a half dozen or more, when heard at one time, produce a medley that is far from harmonious.

NOTES ON THE YOUNG OF CERTAIN SPECIES OF BIRDS.

(Continued from page 147.)

BONASA UMBELLUS.

Ruffed Grouse.

We have seen that there is a great variation in the young of birds, in regard to activity at time of birth; for example, young gannets, which are placed in comparative safety during the earlier portion of their lives, are very helpless for some time, while on the other hand, young terns and gulls which are, as a rule, hatched on the ground, where they are liable to accident, or are in danger from enemies, are able to run almost from the time of leaving the egg, and fly long before they have acquired all of their feathers.

Although among land birds, the majority are comparatively helpless at time of birth, we find exceptions to the rule among the grouse. Probably there is no North American bird that is brought into the world so well developed as the Ruffed Grouse. They are scarcely out of the egg, before they can run nimbly, and their intellectual powers are also quite well advanced, even at this early age, for upon being surprised by an intruder, who might prove an enemy, they almost instantly hide, concealing themselves so effectually as to almost defy detection.

Within five or six days after birth, when all other parts of the body are covered with down, the wings have acquired a full set of feathers and the young grouse is capable of flight. The specimen figured was about one week old, yet as seen, the wing feathers, both secondaries and primaries, are so well developed that the bird could easily fly. I have seen grouse even younger than this one spread their wings, and fly several yards, but at no great height from the ground. At the age of the individual figured, the young ruffed grouse can transport itself through the air with ease, and when a few days older, can fly nearly as well as the adult, but not so swiftly. About the middle of last June, as I was seated on a sloping hillside, in Belmont, at the foot of which was a wooded swamp, my dog, that had been running about among the bushes started a Ruffed Grouse. The bird flew away to some distance, but the dog continued to hunt in the vicinity, when I saw a small bird rise from the foliage and fly upward, alighting on the limb of a maple tree, some fifty yards from where it started, and about thirty feet from the ground. It was about the size of a golden-crowned thrush, indeed, at first I thought that it was this species, but in a moment I saw that I was mistaken, and that it was a young grouse. It stood on the limb with its head stretched the full length of its neck, with the body very erect, much after the manner of the adult. After remaining in this place, without changing its attitude, for a few moments, it suddenly lowered its body and launching out, dropped onto the ground among the luxuriant foliage of the swamp. Wishing to see it fly again, I called my dog, and after a moment he had the bird on the wing. It rose quickly and flew directly toward me across a portion of the hillside; when over my head, not ten yards away, it turned at right angles and entering the wood, flew some fifty yards and alighted on the ground. In all, the distance traversed by this bird was about one hundred yards, and during the whole way it flew strongly and well, but not swiftly. It was noticable, however, that there was no whirring sound produced by the wings, the flight, from beginning to end, being perfectly noiseless.

From a careful examination of the wing feathers, it is evident that they are not fully grown in the specimen I have figured, but that, although capable of performing the function of flight, they continue to increase in length, thus keeping pace with the growth of the bird.

ORTYX VIRGINIANUS.

QUAIL.

We have seen that in one species of gallinaceous birds, the young early acquire wings, in order that they may more readily escape their enemies. Now we come to another species of the same order, in which the wings are developed very much more slowly. I have given the figure of a young quail of about the same age as that of the young grouse (Both being figured on plate XVI, 1, being the quail, and 2, the grouse.) and it will be seen that the quail has not a vestige of a quill feather, the wings being at this age entirely useless to it as organs of flight.

It may appear strange at first sight, that one species of bird should differ so much from another closely allied, and having much the same general habits, in respect to the growth of the wings during the younger stages. I have said that in general habit there was a resemblance, that is, they both live upon the ground for the greater portion of the time, and both subsist largely upon food that they find there. But when we come to examine more minutely into the habits of the two species, we find enough differences to readily account for the absence or presence of wing quills in the very young birds. The grouse lives in the open woods as a rule, where it must escape its enemies, either by running or by flying, rather than by hiding, in fact, grouse when fully grown, more often run away from an intruder, or rise at once upon his near approach and fly away, frequently alighting in a tree.

On the other hand, the quail lives in thickets, especially when young, but seldom in the woods, and thus the young in order to escape by flight would be obliged to move for some distance, beside which they would seldom have an opportunity of alighting in trees. Hence the quail has early learned to trust to concealment, and any one who has chanced to come upon a brood of even newly hatched young, will remember how expert the little, downy fellows are in playing hide and seek: the hiding being accomplished so successfully, that one must absolutely turn over every leaf, bit of bark, or other debris of the section where the young quail have concealed themselves, in order to find them. In short, the hastening of the development of any given part that is of benefit to the animal in its struggle for existence, is here amply illustrated. Thus, while wing feathers are exceedingly useful to the young grouse, being often necessary to save its life, the same appendages would prove detrimental to the young quail, even if it possessed them: an attempted use of them would, in most cases, place the bird more in the power of its enemies, and their growth could only be accomplished at the expense of the advancement of some other part.

HIRUNDO SERRIPENNIS.

Rough-winged Swallow.

As a rule, perching birds are extremely helpless when newly hatched but there is some variation in this respect, depending somewhat upon the situation in which the nests that form their homes are placed. Hence, we find that the young of our species of Swallows, all of which place their nests in sheltered situations, are very weak when newly hatched. I have given an example of the Rough-winged Swallow, Fig.. 38, only a few days old. As seen, the bird is nearly naked with only a little down on the top of the head and along the back. The wings are proportionately long, and the feet and legs are about a proportionate size, but the former named are weak. The bill is, however, disproportionately short and wide, being in fact, nearly triangular in form. Fig. 38, a.

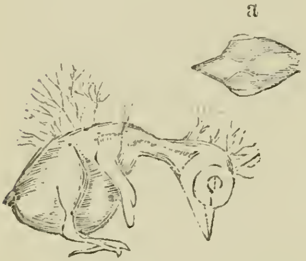


Fig. 38.

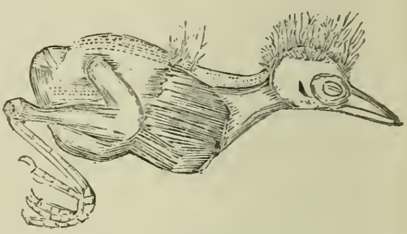


Fig. 39.

HELMITHERUS VERMIVORUS.

Worm-eating Warbler.

In this species, we have a bird that nests on the ground and which is consequently more exposed to the attack of enemies than some of the tree nesters. Consequently we should expect to find the young well developed at an early age, and such is the fact. Fig. 39 represents a young bird of this species, only about one week old, perhaps two or three days older than the young swallow, Fig. 40. As seen, the proportions are even better than in the swallow, although the bird is nearly naked. The wings are long and the quills have made their appearance, while a week later, these have attained a considerable length, see Fig. 40, where the wing of a specimen of the Worm-eating Warbler, two weeks old, is given. The legs and feet are quite large and muscular, and although the young at this age remain in the nest, they are capable of moving about, and quite likely perch on bushes at an age when the young of many other species of the family are still in their nests.

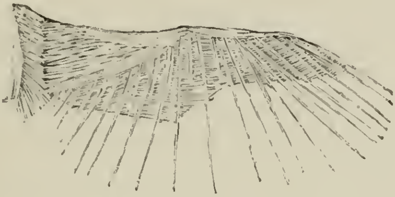


FIG. 40.

SCOPS ASIO FLORIDANUS.

FLORIDA MOTTLED OWL

All of the birds of prey with which I am acquainted, are hatched covered with down, but are at first quite helpless. They rapidly acquire strength, however, yet do not leave their nests until nearly or quite fully grown. Thus the young of the Bald Eagle is even larger than the adult before it attempts to fly. Young Owls, especially those that breed in holes, emerge from their retreats, when not fully grown, but do not wander far from their home, and probably live in the hole in which they were born during the daytime for quite a long time. As seen, this young Owl, Fig. 41, is well proportioned.

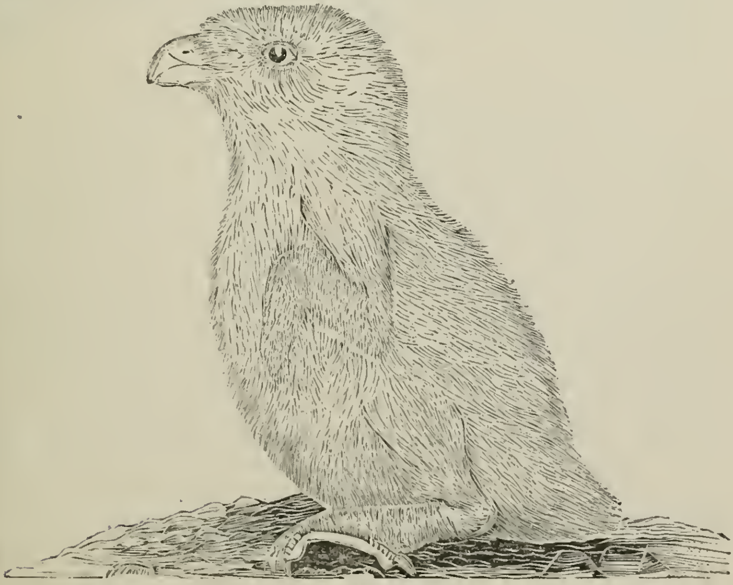


FIG. 41. Young Florida Mottled Owl, one week old.

THE SOUND PRODUCING ORGANS OF BIRDS.

Continued from page 106.

Since writing the concluding sentence in the article on the sound producing organs of the woodcock, I have had an additional experience with this species, that tended to confirm the idea that the whistling sound is used as a note of alarm or warning. Early in April, I was walking in company with my dog near an alder swamp, once a famous breeding ground for woodcocks, but which has long since been abandoned by them for this purpose, on account of its present proximity to a number of houses. Wishing to see if any ever alighted there now. I sent in my dog, and in a moment he had a fine male on the wing. The bird rose within fifteen feet of me. and whistled most vehemently as it got up and continued whistling until it was some distance above the bushes. Judging from the size and color, as well as its whistling, that this bird was a male, I once more sent the dog into the swampy patch. He went directly to the place where he started the other bird, and came to a stand within a few feet of it, when a smaller, paler woodcock rose, as far as I could hear, silently, and noiselessly flitted away. I have not seen it mentioned that the female woodcock never made the whistling, and I think they do at times, but in this instance the female had received a most emphatic warning from her mate that danger was near, and after remaining in concealment till the dog's nose was within a few feet of her, got up as silently as possible, her idea evidently being to steal away unobserved.

COCCOTHRAUSTES VESPERTINA.

Evening Grosbeak.

The sound producing organs of this species are most peculiar. The sterno trachealis, Fig, 44. d, s. s, is moderately well developed, and has its origin below the division of the bronchialis, ib., c, B, S. Both divisions of the brochialis are well developed ib., c, B. The four lowermost tracheal whole rings are fused together, Fig. 44, b, and the upper portion of both bronchial muscles are attached to them, and below to the three lower, free tracheal rings and to the three laryngeal half rings, but not at all to the bronchial half rings. There is a vibratory space between the upper bronchial half ring, and the lower tracheal ring, ib., f, g, that is governed by a singular, thin. Y- shaped muscle, that extends from the two upper bronchial half rings, to a muscle that is spread between the bronchial tubes their entire length. See ib., d, I, and ib., e, where is given a very greatly enlarged view of this muscle, but all the figures are enlarged twice the natural size.

The tympaniform membrane is peculiar, for the first three half rings it is vibratory, and triangular in shape, then narrows, so as to become nearly or quite functionless, being a mere division of the bronchial rings; id., v, is the vibrating surface; below it the narrow portion.

Although the os-transversale is present, and supports a very slight semiluna membrane, the bone is so firmly fixed that it cannot oscillate in any degree, see ib., a.

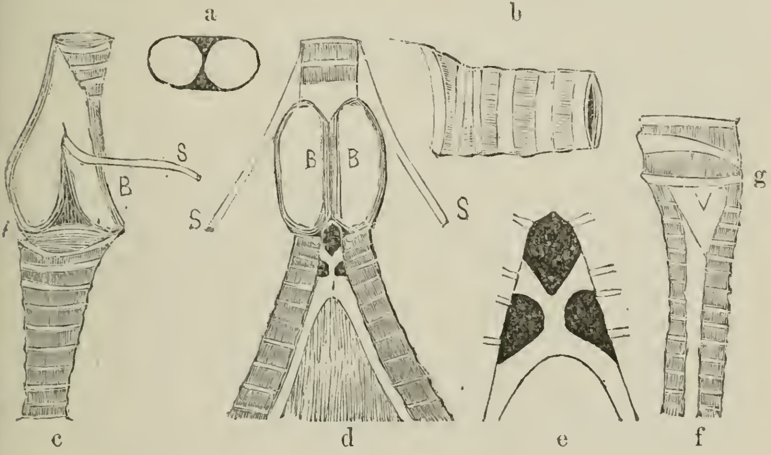


FIG. 44.

With such a musical apparatus as this, the Evening Grosbeak must give a most peculiar song, and according to accounts, this appears to be a fact.

STRIX AMERICANA.

American Barn Owl.

This owl has a somewhat peculiar inferior larynx. The sterno trachealis, Fig. 43, a A, is very large, and has its origin on the trachea low, only about .25 from the larynx, and below it is a very small bronchialis, ib., h. The bronchial tubes are very long, having twenty-five half rings, ib., b, and the tympaniforms extend their entire length. The os transversale is present and supports a well developed semiluna membrane. The notes produced by the Barn Owl are quite different from those of any other species of owl that occurs with us, and a comparison with the vocal organs of other species figured in a continuation of this series of articles, will show considerable difference in the various parts.

CROTOPHAGA ANI.

Ani.

This singular bird has a very harsh, unmusical cry, and it was with considerable interest that I examined its vocal apparatus. I found this quite unique in some respects. The sterno trachealis has its tracheal origin about .25 above the division of the bronchial tubes, and is moderately well developed. Fig. 43, g. The bronchial tubes are peculiar, each tube being composed of nine whole rings above, beginning at the division at the larynx, then below these, are six half rings with the tympaniform membrane within them. See ib., g, f, being the half rings. Although there is a slight os transversale it does not support any semiluna membrane, hence all the notes of the bird must be produced by vibrations of the short tympaniform.

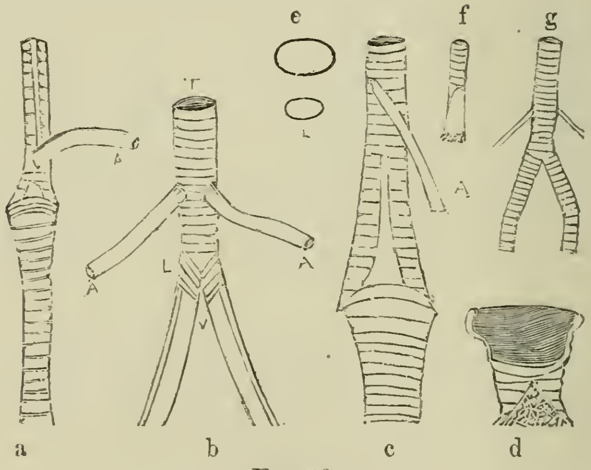


Fig. 43.

PHOENICOPTERUS RUBER.

American Flamingo.

In the American Flamingo, the inferior larynx is extremely simple. The sterno-trachealis, Fig. 43, c, A, is moderately well developed, and has the usual sternal attachment. There is a very thin strip of a bronchialis, having its origin about .40 below the sterno-trachealis, and then extending downward about .75, adheres to the upper bronchial halfring. The bronchial tubes are very short and wide, ib., d, and the tympaniform membrane is also short, occupying only the upper portion of the inside of the tubes, ib., d, e, being the lungs. As there is no os-transversale nor any other vibrating surface, other than the tympaniform membrane, all of the notes which this species utters must be produced by this membrane, but aided, without doubt and greatly modified, by the great length of trachea, which is from 22.00 to 24.00 long. The cries of the Flamingo are not unlike those of a Wild Goose, but are rather mellower, and not so loud.

SOME INSCRIPTIONS
FOUND IN HARTFORD CAVE, RUM KEY, BAHAMAS.

But little appears to be known of the history of the race of Indians that inhabited the Bahamas, when Columbus discovered the islands four centuries ago. We know from the accounts of this famous voyager, that there were Indians there when the Spaniards took possession of the Bahamas, and furthermore, that they were a gentle race who soon fell a prey to the rapacity of their conquerors, being captured by hundreds and taken to Cuba as slaves in order to work in the gold mines. It is extremely probable, that partly through ill treatment, and partly through being unaccustomed to hard labor of any kind, these Caribs did not long survive in captivity, hence it was that a constant demand was kept up for slaves, consequently the various islands of the Bahamas were drawn upon till the whole group were absolutely depopulated, and a race was swept from the surface of the earth with its history unwritten.

Every fact then, that will give us any knowledge of these lost people is of value, and as I have been fortunate enough to have visited the only known cave on the Bahamas, which contains ancient inscriptions, evidently the work of the Caribs, I have given an account of it below.

Rum Key, on which this cave is situated, is a small, round island about six miles in diameter, with high cliffs and rolling hills to the northward and eastward. To the southward, where the harbor is located, the land is lower, but no part of the island is absolutely level for any great extent. It is on the north side of the key that the cave is situated, and on January 20, 1888, through the kindness of Messrs. H. C. and C. H. Neill, who were then resident on the island, I was enabled to visit it.

I started about noon from the little village near the harbor, in company with Mr. H. C. Neill, each of us mounted on one of the small, but wiry horses which are bred on the island. The road we took led us directly across the island to the eastern side, passing within sight of a beautiful lake of salt water, containing some twenty-five acres, and so deep as to be intensely blue in color, while, as it is completely embosomed by hills, clad in brilliant green, the effect produced by the contrasting colors is very fine. The waters of this lake are said to be well stocked with green and hawksbill turtles, for which there is no outlet for escape.

Arriving at the eastern side of the key, we took a creole as a guide and he conducted us along an interior road, to the north shore to what is known as Hartford Hill, one of the highest elevations on the key. There are some ruins of houses on this hill, but at the time of my visit all of this portion of the island was uninhabitated. At the foot of the hill we dismounted and made our way across the elevation, being somewhat retarded by the thick growth of shrubbery that everywhere covers the ground. Reaching the shore, here a rugged mass of rocks, we turned to the westward, proceeding till we came to a narrow sand beach, midway on which is the opening of the cave, in a limestone cliff which is some fifty feet high.

The entrance to this ancient domicile was a low arch not over twelve feet high, but some fifty feet in long diameter. Just as we entered, the sun was nearing the water in the western horizon, and by reflection shone directly into the interior, illuminating it much more thoroughly than it would have done even at noon day. I found a rounded chamber about fifty feet in diameter, with smooth, evidently water worn walls, rising some fifteen feet nearly perpendicularly from the white sandy floor to the arched roof. There were a few gray stalactites, evidently forming slowly in wet weather and crumbling in dry, so that the rate of decrease was nearly equal to that of increase.

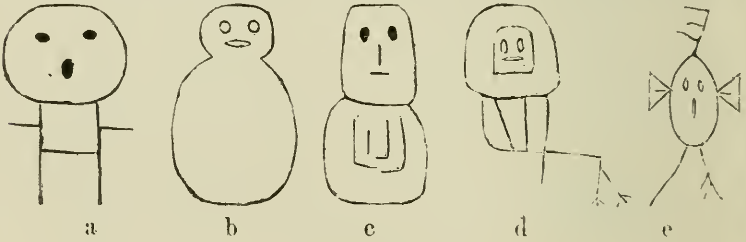

a b c d e

Fig. 45.

The walls were of lime rock, grayish in color, and covered with distinct, though rude figures of human beings and other objects, formed by lines cut in the stone to the depth of half an inch. As the sinking sun gave me comparatively little time for observations I hastily sketched ten of the principal figures, which I have given in the accompanying cuts.

In endeavoring to ascribe some reason for the presence of these figures in this particular cave, I have formed two theories. First, that they were placed there in commemoration of the landing of Columbus, on either this, or a neighboring island. It is a mooted point, not only with historians, but also with the inhabitants of the Bahamas, as to which particular key should claim the honor of having first felt the foot-tread of the celebrated navigator. That he landed on some island in the immediate vicinity of Watlings, is probably true, and that he afterwards visited many other keys, is also an undoubted fact. As Watlings is almost within sight of Rum Key, and as this little, round island is high and prominent it is extremely probable that he visited it at one time or another.

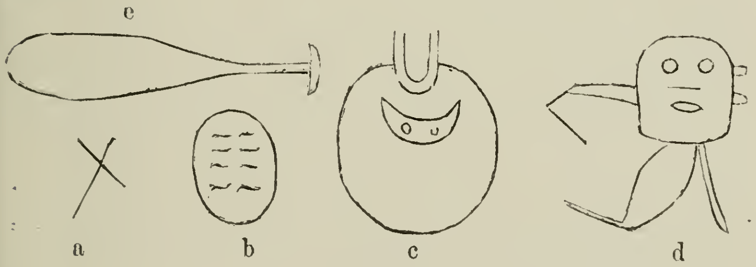


Fig. 46.

My reason for thinking that the inscriptions were made in commemoration of the landing of the white men, may be found in the figures themselves. Fig. 45 e, appears to me to represent, of course with the utmost rudeness, a man carrying a banner, ib., d, is possibly a man in armor, Fgi. 46, b and c, are shields, and at ib., a, we have an unmistakable cross. Fig. 46, e, is a paddle, the other figures are not so easily interpreted. The largest figure is the paddle, which is about three feet long, indicating that it was a large one. The shield, Fig. 46, b, with the cross, is the smallest figure being about a foot high and the others are intermediate in proportion.

Mr. Neill informed me that there was a figure of a canoe in a darker portion of the cave, but the gathering twilight prevented me from seeing this. These inscriptions might be interpreted as follows; the men here figured, arrived at this place in a vessel of some sort, as indicated by the canoe, which was propelled in some extraordinary manner, as seen by the disproportionately large size of the paddle. The strangers whom this vessel bore were clad in an unusual manner. Fig. 45, d, has on a hood or more likely a helmet. and Fig. 45, e, has some singular appendages attached to his person. The shield, cross, and banner also appear to indicate that Europeans were here represented.

In objection to this theory it may be urged, that the very fact that there are no other inscriptions now known on the Bahamas. would tend to prove these could not have been made by the natives for, even as rude as they are, they must have been made by a practiced hand, while a people unaccustomed to recording events in this manner, would never have begun to do so in such a comparatively elaborate manner. True, but we do not know but that records were made by these Indians on surfaces of the usual lime rock where the inscriptions were exposed to the weather when they would disappear in a comparatively short time, besides, we have no evidence that all of the figures in Hartford cave were made at one time, or that they were intended as records of the same event. The resemblances of the figures to some of the objects mentioned by me may be fanciful, and certainly the presence of the cross may be accounted for in other ways than by the Indians having seen it in the possession of the whites. It was a common emblem among certain South American tribes, and with the Indians of Yucatan and Mexico. In spite of these objections, I cannot but believe in the plausibility of the theory that the inscriptions in Hartford cave were made by some Indian, who witnessed the arrival of Columbus in the new world four hundred years ago, and that he intended to hand down to posterity the record of this wonderful event, by making these inscriptions.

Another theory for accounting for the presence of the inscriptions in Hartford Cave, is that natives of some other section were by chance carried to Rum Key at some time, and recorded their visit by the inscriptions. Archæologists will probably trace a resemblance between the figures I have given, and the idols or other sculptured figures of the tribes that inhabited Yucatan.

My opportunities for examining the cave were so small, as related, that I do not feel like strongly insisting upon either hypothesis advanced as the correct interpretation of the inscriptions. It is possible that upon visiting the place again with more time at my disposal, I might come to a widely different conclusion. I have never seen any account of this cave, thus this mention of it may call attention to it among experienced archæologists. I may say, that all of the natives on Rum Key with whom I conversed about the inscriptions regarded them as very ancient, indeed, I think most of the creoles believe the cave to be haunted by spirits of Indians, which may account for the fact that none of the inscriptions were ever injured in any way.

The Cave probably had its origin through the action of sea water when the Key was submerged, then when the Bahamas were elevated to their present height, through some convulsive change, it was placed in its present position, above the reach of ordinary waves. I do not think however, that this cave could have been used as a constant residence as it is in momentary danger, from its proximity to the water, and open entrance, of being flooded by the billows during hurricanes. In fact, the floor bore evidence of having been swept by the sea during the severe gale that occurred on the Bahamas, the previous September.

NOTES ON WEST INDIAN BIRDS.

The following notes are the results of two season's experience in the Bahamas and other West Indies, and as far as practicable I have given the matter much as I wrote it from day to day in my journal, supplementing these notes, however, with explanations, when necessary, then in most cases, concluding the account of each species with a summary.

DORICHA EVELYNAE.

Bahama Wood Star.

Nassau, Jan. 22, to 28, 1884. These Humming Birds are very common, but all taken are young females, many of which have only recently left the nest. I have not yet seen a single male, not even a young one. They have a chirp like that of the Ruby-throat, feed high or low according as the plants grow, and are found everywhere, in the scrub, by the road-sides, or in the gardens.

I saw one taking a bath in a broad leaf that grew near the ground and which contained a few drops of dew. I was standing within a yard of this miniature bath tub, and watched the little fairy perform its toilet with great interest. This it accomplished by rubbing its breast against the leaf, thus managing to wet its feathers with the dew. It then perched on the leaf stem, and after shaking itself a few times proceeded to arrange its plumage with as much coolness as if I had not been present, although I could see by the glances which it occasionally directed at me, that it was perfectly aware of my proximity.

Those that I have seen, frequently alight as if weary. [This habit I have observed with all species of West Indian Hummers.] Where are the males, both adult and young?

Feb. 2d. I have at length seen a single adult male, and have taken a young of the same sex. These Hummers occur everywhere that flowers are found, even in the comparatively barren pine wood. On the 9th. inst. saw two more adult males.

Feb. 23d. The young are moulting, and are evidently about to assume the full adult dress. Adults are not yet common, but the young continue abundant.

March 2d. Today Governor Blake showed me a nest of the Wood Star built in a mimosa tree that stood in the garden of the government house at Nassau. It was situated at the extremity of a limb. much in the manner of that of our Ruby-throat, and was about ten feet from the ground. On the 4th instant, we again visited it, and by ascending the the tree, I could see that it contained two young. While we were standing beneath the nest, the female came and alighted on the tree above. After surveying us a moment. she darted down, settled on the nest and proceeded to feed both young, first one, then the other, this being accomplished by regurgitation, She put her beak into the mouth of each offspring, much after the manner of pigeons. keeping it there for some seconds. After feeding the second she returned to the first. She then left the nest, and alighted on the tree above it, remained a moment. darted off, disappearing almost instantly.

March 8th. I think that the young males of this species of Hummer moult the two central tail feathers, which are at first nearly as long as those of the female, and retain the remainder of the tail feathers, then when new feathers appear they only grow as long as in the adult males. [Subsequent careful examination disclosed the fact, that these two central feathers, although considered by writers as true tail feathers do not belong to the tail at all, but are merely elongated upper coverts, and grow some higher than the regular tail feathers.] All of the young are now moulting, but two adult males taken within a week have been perfect.

March 18th. Shot a female Hummer that contained an egg nearly ready to deposit, and another specimen that was evidently incubating. I witnessed a battle between two males today. One attacked another which was passing and both ascended about fifty feet in air, fighting fiercely all the time. One soon conquered, driving the other away. when the victor hovered a moment high in air, then dropped perpendicularly to within a few feet of the ground and alighted on a bush. This occurred in the pine woods which appears to be a favorite resort with this species. The alarm note is a sharp twitter.

On the 16th. inst., three nests were brought to me; two empty and one contained a young bird nearly fledged. All of these nests were placed in sapadillos near the ground. I tried to feed the young bird.

but it would not attempt to eat until the next day, when it took condensed milk, syrup made of sugar, and bits of raw meat. It only lived two days, however. It had a chirping note, quite loud for the minute size of the bird.

March 17th. Took a nest from the yard of a Congo negro who lived at Fox Hill. This was built in a small alligator pear tree within a foot of the end of a limb that grew out toward the house, and only four feet above the ground. It was within ten feet of the door, and directly in the path which led from the house to the road, where members of the domicile must have brushed it in passing every hour of the day. The female sat on the nest until I was within a foot of her, when she flew away. This nest contained two newly hatched young, only a few hours old.

[The Congo negroes, of which there are two or three colonies on New Providence, former slaves released from bondage by the vessels in which they were being conveyed from Africa to the West Indies, having been captured by British men-of-war, and there descendents, call this Hummer the God bird. I expected that they would at least have some superstitious belief concerning it, which would tend to make them adverse to having the nests taken, especially when built in their yards. On the contrary, none of them ever expressed the slightest regret about the matter. The only objections that any ever made was when I wished to cut off the twig of some fruit tree to which a nest was fastened, but a bribe of a few pennies always appeared to amply idemnify them for this slight damage. It may be remarked, that neither the negroes nor the lower classes of creoles have advanced enough in the intellectual scale for mere sentiment.]

Later in the day while seated in the yard of another Congo negro, I saw a female Hummer come into a sapadillo tree which grew over my head, within a few feet of where I was sitting. She held a bit of cotton in her beak, which she deposited on a branch and then began arranging it with her little bill. After this she pressed it down with her throat, and then tramped it into place on some other cotton, already there, by walking round and round. She then flew away, but quickly returned with more cotton which she arranged as before. This was repeated several times while I remained. But the most singular thing about it all was the fact that a negro woman was seated on the ground beneath the tree, with her wooly head within a foot of the nest, while neither she nor the bird paid the slightest attention to one another. This nest was placed on a limb that grew directly beside a path along which several persons passed many times daily.

Later still the same day, while in the yard of another house, conversing with an old negro who was making baskets, seated on a bench beneath some fruit trees, I observed another female Hummer go to a half finished nest in the tree over my head. [As illustrating a peculiar trait of character of these negroes, I will say, that I had just been informed by the basket maker that there was not a single nest of a God bird in the yard and his look of astonishment when I called his attention to this nest within three feet of his head, fully testified to the truth of his belief. Power of observation is almost entirely lacking in these negroes.] We continued to find nests of this Hummer, often in the yards of negroes but singularly, never saw a single male in the vicinity of a nest.

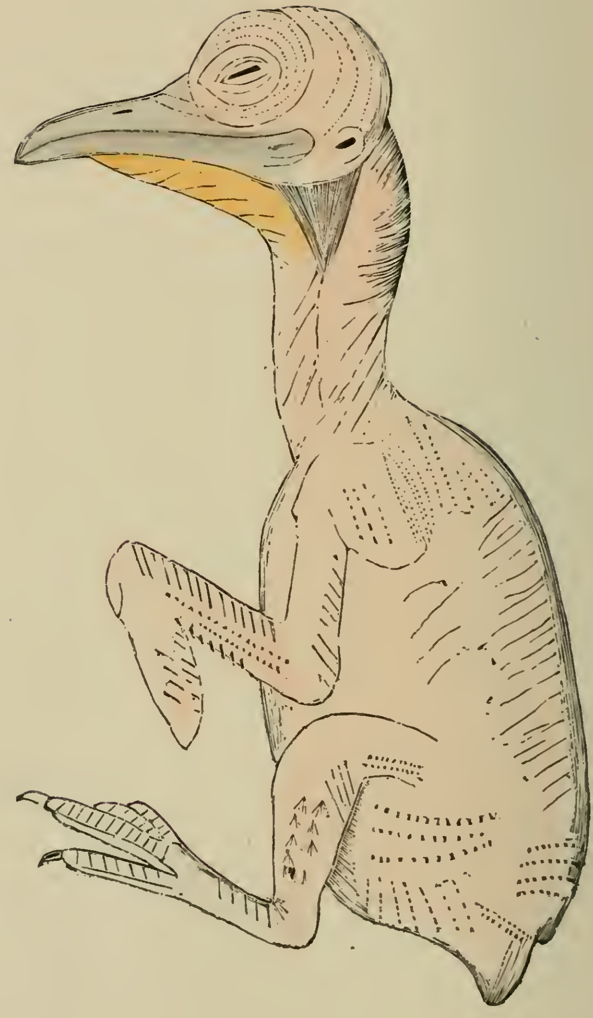
March 29th. On the twenty-seventh, found a nest built in a sapadillo, twenty feet from the ground [an unusual height] which I discovered by hearing the sound of the wings of the bird as she flew from it, and then watching for her return. This nest contained but one egg that was considerably advanced in incubation. The female buzzed around my head as I was examining the nest, coming within a foot of my face, [an unusual occurrence, as the birds almost always appeared indifferent as to the fate of their domiciles, even when these contained young.] No male about this nest: in fact, I think the males comparatively rare anywhere, as I did not see more than one to every twenty females.

On the twenty-fifth instant, I was shown a nest in a mango tree, that grew in a negro's yard within three feet of the back of the house, and about eight feet from the ground. It was empty, but I was assured that it had contained an egg a day or two before. I concluded that the bird had abandoned her home on account of a small twig that had grown up through the nest.

When near our house, I caught a female in my insect net, but I fear injured her somewhat, for she only lived until the next day, although I gave her the liberty of the rooms in which there were abundance of small insects upon which she fed eagerly, in fact, her stomach was filled with them when I gave her remains a post mortem examination.

South Bight, Andros, April 20th. The Wood Star is common, both here and at Fresh Creek, but strangely, I have not seen a single male. A female was so tame that it allowed me to walk within two feet of her as she sat on the low limb of a tree. At nightfall, when I was in a buttonwood thicket waiting for White-crowned Pigeons, a Hummer came to roost, alighting within four feet of my head.

PLATE XIV.



Young Man-of-war, Tachypetes aquila, two days old.
Taken on Little Cayman, April 20th., 1888.

Deep Creek, April 24th. Shot a young male moulting into the adult plumage. Saw others.

South shore of Andros, April 30th. Have seen a few specimens of the Hummer among the small keys that lie in the shallow water that skirts the main island.

Grassy Creek, May 6th. As I was making my way over the rough rocks, a Hummer of this species alighted within two feet of me, and scrutinized me with the utmost inquisitiveness, continuing to look at me as long as I remained near. When I returned after an absence of some fifteen minutes, it was still on the same bush.

Nassau, May 28th. The Hummers are particularly abundant, especially in the pine woods, and I saw hundreds yesterday, but all were young, not a single adult did I see of either sex. Young males with rufous throats in which are sprinkled a few of the metallic-like feathers of the adult plumage are common. These young birds were very unsuspicious and very inquisitive, often coming within a foot of my face to examine me. They perch very frequently, and as I passed them would fly to me and peer into my face, suspending themselves on rapidly vibrating wings in front of me, in order to obtain a good look; then fly to a twig in advance, only to again examine me as I came up. Some would follow me for a long distance in this way. They were very playful; if one is sitting on a twig, another often comes darting past it, with a speed so rapid, that the eye can scarcely follow its motion. As it dashes by, the one perching utters a series of shrill notes, almost shrieks, then darts away in the track of its companion. Now begins an exciting race; the little migits dart right and left, up and down, describe eccentric circles, in short, perform many aereal evolutions, all with almost the speed of thought, for they have scarcely seemed to have met, before they have accomplished it all, separated, and one is back again, satisfying its curiosity by another look in my face, or another peep into my gun barrels.

I found the Wood Star common at Nassau during November, 1887, and also on Andros in December of the same year. All seen were, however, in the young plumage.

SUMMARY.

As seen by the foregoing account, the Bahama Wood Star probably breeds for a greater portion of the year, and as a result of this prolificness, the individuals are very numerous, especially in the young stage of plumage. There must be great mortality among them, however, by which a large number are destroyed, for even at a small rate of increase they would become extremely abundant. The adults, especially the males, seem to be comparatively uncommon, at least I have never seen many of them in this stage of plumage. It is possible, however, that like the Lyre-tailed Hummer, [for an account of which, see following article] the males congregate together, and that I never chanced to find them.

They are extremely tame, more so than any other species of land bird that I have ever seen, excepting, perhaps, some species of Jamaican birds. This is probably due to the fact that they are seldom, if ever, molested by the natives, consequently, fear of man has not been inherited by the young.

The nests are not unlike those of most North American Hummers, but are less often covered with lichens, bits of bark, etc., though this is occasionally done. The eggs are usually two. Young males in first plumage closely resemble the females.

DORICHA LYRURA.

Lyre-tailed Hummingbird.

Inauga, Feb. 8th. 1888. I found this species of Hummer common on this island, [It is confined to this and Long Island, as far as known] both sexes, in adult and young plumages. They are rather more sluggish is movement than is D. evelynae, and have quite a pretty series of twittering notes which they give when alarmed, or when they see something which they do not understand. They feed upon the flowers of the silk cotton tree, the aloe, and a peculiar scrub that grows in the wooded sections. I saw one try to extract honey from the brightly colored label of a tomato can that sat in my window at Mathewstown.

I have repeatedly seen them alight when feeding, and cling to the plant, indeed, this appears to be an established habit. Hundreds congregate along the shore to feed upon a species of plant that resembles a honeysuckle, that grows in the open space between the beach and the scrub. [In fact, I saw more Lyre-tails here in one hour, than I have ever seen Ruby-throated in my life.] Singularly, all in this section were males, and many were adults, but every stage of plumage was represented, from the first feathers to the beautiful dress of the old birds. The males, unlike those of the Wood Star, do not, at first, have the tail of the female. The adult males are quarrelsome, like most species of Hummers. They are very unsuspicious, and I have seen them feeding within a foot of me. A nest that I found which I supposed was constructed by one of this species, does not differ essentially from those of the Wood Star. The generative organs of the males showed signs that the birds were about to breed.

SUMMARY.

As seen, this species does not differ greatly from its ally, the Wood Star, excepting in being much more sluggish, hence we should expect to find it restricted in range, as it certainly is, none, as far as known, having been taken off the island of Inagua, excepting on Long Island where it is rare. D. evelynae does not occur on Inagua, according to my observation.

SPORADINUS RICCORDI.

RICCORD'S HUMMINGBIRD.

South Bight, Andros, April 20th., 1884. I have seen in all, something like a dozen specimens of this species. The hum of their wings is louder than that of D. evelynae. I have seen them feeding on the passion flower. The first specimen that I collected was a female at Fresh Creek. I was in the scrub when the bird appeared and hovered within a few feet of my face, then alighted on a twig, but was off before I could shoot, yet she appeared again and again until at last I got her.

The second specimen I took was also a female, and was procured at South Bight in an old field. She was sitting on a dead tree. All of the others which I have seen have been males, three of which I have shot. I have as yet heard only a chirping note, louder than that given by the other Bahama Hummers. When the bird is hovering, the tail is held well forward and not spread. On one occasion I saw two males plunging about one another, evidently in sport, as the chirping which both made was not loud. At another time I saw two flying through the top of a high pine tree, but they all appear to prefer the shrubbery on the edge of openings. When the males are flying in the sun, the green of the throat catches the light, and gleams like emerald. That portion of the bill which is light colored in the skin, is bright orange in life, but this color is so evanescent that it fades within a few moments after the bird is shot.

Deep Creek, April 4th. Shot a male and saw a female in a field.

Grassy Creek, May 6th. I have not seen a single specimen of Riccord's Hummer, either here or to the southward.

Fresh Creek, Nov. 27th., 1888. I have seen only two specimens of Riccord's Hummer, both in a field.

Middle Bight, December 20th. I saw only one or two. I saw one descend spirally into one of the deep pit holes, that occur on this island, in search of insects, performing the downward and upward movements very gracefully.

SUMMARY.

I have never found this species at all common, even on Andros in summer, while in winter it is rare. It may be that they migrate. This is a Cuban species, Andros being somewhat out of its supposed range. I know nothing of its breeding habits.

MIMOCICHLA PLUMBEA.

PLUMBEOUS THRUSH.

Nassau, Jan. 29th., 1884. When I was in the scrub where it was quite dense and high, a Plumbeous Thrush suddenly appeared. It was bending down to look at us when I shot it. A little later, near the same spot, another was seen, attracted by a squeaking noise that I made. This one was quite shy, flying once, but I succeeded in securing it also. They had no note and both were females.

Feb. 2d. While I was walking along the Village Road, which leads from the pine woods to the town, just at nightfall, a Plumbeous Thrush started up from the ground in a side road, where it had evidently been feeding, and flew into the scrub. This also proved a female.

Feb. 7th. A specimen, also a female, was brought to me having been shot by a creole.

Feb. 15th. While I was calling for the Greater Yellow-throat in the high scrub near the pigeon hooters, [The creoles who hunt the white-crowned Pigeon, in order to attract them, imitate their cooing, which sounds are called hooting.] I heard a bird singing that gave some of the notes of the Cat Bird, some of the Bahama Mocker, and some of the Brown Thrush. I made my way carefully through the thicket until I was directly beneath the bird, when I saw that it was a Plumbeous Thrush. I shot at it but failed to secure it.

Feb. 21st. I think the Plumbeous Thrushes are increasing in numbers. Heard one giving a singular alarm note as I was walking along Wulff's Road. This note reminded me of the cry of the Ani, and also of some of the notes of the Quail. [See notice of the vocal organs in Vol. II, No. 1 of Contributions, under head of Notes on the Vocal Organs of Birds.] The bird when uttering this cry is often exceedingly restless, jumping about excitedly.

Feb. 22d. Shot one on the Fox Hill Road which I decoyed within reach by imitating the cry of a Crotophaga.

Feb. 23d. Shot one on Kemp's Road in a place where I have never seen one before. I am certain that they are increasing in numbers.

March 4th. Have seen a few, there being most evidently a partial migration.

March 16th. I think it is a usual habit for the Plumbeous Thrush to feed on the ground, as I shot one on the 8th. inst. on burnt land, and have seen two or three others since that time on the ground.

March 29th. The alarm note is peculiar; three or four notes given in succession, something like those of a Wood Thrush. I saw one perched on the top of a pine that grew out of the thick scrub. The bird was at least forty feet from the ground, and was singing. Its lay sounded something like the syllables , "tee-tuc-ta-day" with the principal stress given on the last two.

South Bight, Andros, April 20th. Shot a specimen of the Plumbeous Thrush, and saw another. A nest was pointed out to me that was built in a small tree which stood in a clearing, that was said to have been occupied the past season by a pair of these birds. It was placed about fifteen feet from the ground, and was made of sticks, resembling quite closely the nest of a Blue Jay.

Deep Creek, April 24th. Shot two Plumbeous Thrushes, both were on the ground running along a path. Saw another perched on the top of a high tree, singing. The song is loud, clear, and bell-like, and reminded me strongly of that of the Wood Thrush, especially as here the country is more heavily wooded than on New Providence, with deep secluded valleys, in the neighborhood of which are small clearings which are favorite resorts of the Thrushes. I saw another nest in a small field built in a similar manner as the one mentioned as found at South Bight. I did not go up to it as I could see through the bottom that it did not contain any eggs.

Nassau, May 27th. The Plumbeous Thrushes are much more abundant now than before. I hear them singing in all directions. The notes now are quite different from those given earlier in the season, sounding like "ar-cheer." uttered loudly with a Thrush-like intonation, and followed by two mellow whistles. I have seen specimens stand perfectly still when they observed me, evidently trusting to thus avoid observation.

May 28th. Shot a specimen that, upon dissection, proved a female which had an egg in the lower portion of the oviduct, that would have been deposited in a few hours. It was unbroken and with the shell completely formed. This egg is pale greenish or bluish, finely spotted with pale reddish or rufous. Dimensions, 1.10 x .75.

Shot a male which fell wounded, and as I was endeavoring to catch him, a female came about, uttering a long, singular cry. The usual alarm note is "took-took-took" given very rapidly and harshly. Individuals vary greatly in song, some giving many more syllables than others.

After shooting the above mentioned female that contained the egg, I made a careful search for the nest, and succeeded in finding an old one of the previous season. It was made of strips of bark and small twigs, thus closely resembling the nest of the Cat Bird.

June 2d. I found them singing in all directions, evidently breeding. At this time there was much variation in the song.

Dec., 1887. No Plumbeous Thrushes neither on New Providence nor Andros.

Inauga. Feb., 1888. Saw none on this Island.

SUMMARY.

This species of Thrush is most evidently migratory on the Bahamas, but where it passes the winter is a mystery. Some begin to return to the islands late in January, but the greater portion do not arrive upon their breeding grounds before April and May. They nest late, probably mostly in June. The song is quite variable, but is characteiristic enough to render the bird recognizable whenever heard.

The Plumbeous Thrush was first brought to notice by Mark Catesby and was figured by him. (Natural History of the Carolinas, Florida, and the Bahama Islands, Plate XXX, 1754.) Linnaeus in his X edition of Systema Naturae, 1758, page 159, bases his description on this notice and figure, but from the time of Cateby's discovery until the visit of Dr. Henry Bryant to the Bahamas in 1859, a period of over one hundred years, this bird was practically a lost species. Dr. Bryant took three specimens on New Providence, but evidently misled by the confusion of names applied to members of this genus at that time, called them M. rubripes, (See Proceedings of Boston Soc. Nat. Hist. VII, 1859, page 114.) but in a narrative of a second trip to the Bahamas, he corrects this error by recording the species as Turdus plumbeus and says "I tried hard to procure additional specimens of this interesting species but without success", (Proceedings Boston Soc. Nat. Hist., 1863, page 68.) clearly indicating that he had taken some of M. plumbea during his previous visit, but he makes no mention of any member of the genus, excepting rubripes, hence we are led to infer that the three specimens given under the head of Turdus rubripes were really Plumbeous Thrushes and not Red-legged Thrushes. Indeed, upon referring to Prof. Baird's Review of North American Birds, 1864, part 1, page 36, we find that the M. rubripes of Bryant is given as a synonym of M. plumbea. Upon referring to the list of specimens at the end of this article, we find that Prof. Baird had one of Dr. Bryant's original specimens in hand, thus he could not have been mistaken. Hence, up to date, no authentic record has been made of the capture of M. rubripes on the Bahamas.

The bill of M. plumbea is black, but with a decided undertinting of carmine. Iris, brown. Narrow naked space on inner margin of eyelids. inside of mouth, including tongue and feet, bright orange carmine. In M. rubripes, the feet are orange and the bill brown. But this species differs mainly from M. plumbea in having the abdominal region and thighs chestnut.

MIMOCICHLA RUBRIPES.

RED-LEGGED THRUSH.

Cayman Brac. March 31st., 1888. The song of the Red-legged Thrush is quite different from that of M. plumbea. The bird does not appear to be common. The first that I saw was feeding on the ground not far from a house; the second was in the phosphate field [A section where the ground had been dug over in order to procure phosphate] perched on the top of a mango tree, and was singing. The third was in a tree near the door of my house, on March 28th. This I shot; no indications of breeding. Shot two more in a fig tree in the phosphate fields. [There were two or three large wild fig trees in this field, which bore a small fruit, that when ripe was very sweet, and some species of birds came in large numbers to feed upon them. Sometimes fifty or more of four or five species would congregate in one tree, but the rarest visitor was the Thrush.] They act much like Robins, one that I saw to-day fluttered its wings as it alighted to feed, much as I have seen Robins do, and one before beginning to eat emitted some harsh cries.

April 5th. Found the Thrushes quite common on the plantation at the east end of the island. They have a harsh note and the habit of sitting perfectly quiet as times.

This species occurs on Cuba and it is rather singular that it should be found on Cayman Brac, inasmuch as an entirely distinct species has been described from Grand Cayman by Mr. Cory, M. ravida, which has the bill orange, the throat without white stripes, and no chestnut on the abdomen. I did not find any Thrush at all on Little Cayman.

SOME METEOROLOGICAL PHENOMENA.

The following accounts of Meteorological phenomena have been recorded by me at various times, and the sketches were made at the moment of observation. As will be seen, these peculiar appearances have usually preceded storms.

When encamped on the west end of Way Key, Florida, a short distance from Cedar Keys, in 1874, I observed a peculiar appearance of the sun at about the time of its setting. This was on the evenings of February 25th., 26th., and 27th. There was a fog bank in the west, lying low down over the waters of the Gulf of Mexico, and as the sun approached this bank on his downward way, his lower disk was flattened, Fig. 47, a. It may be here observed that the fog was not dense enough to obscure the sun at all, as will be seen further on: hence the part missing from the disk was not hidden. As the sun neared the horizon line, a spot or portion of his surface suddenly appeared, seemingly, on the surface of the water, and at a greater distance from his center than would be included in the circle of his disk, ib., b. This spot gradually broadened out and finally joined itself to the main body above, resembling, somewhat, a balloon, ib., c. Then it was observable that the fog bank was not dense enough to obscure any of the sun's brilliancy, for he shone with equal splendor over his entire surface, looking large and red. The next change was when the orb of day was half submerged in the water, when he began to be divided into two parts ib., d. These divisions proceeded rapidly until the notches on either side met, leaving an oblong patch, before the sun quite disappeared, with a distinct line between it and the water, ib., e.

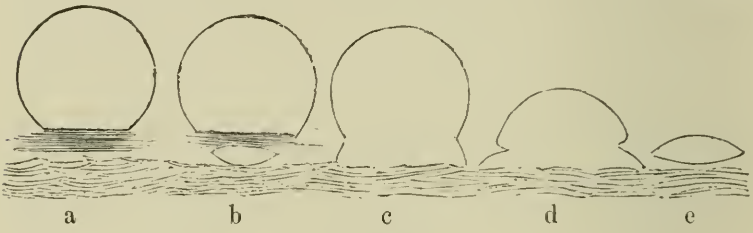


FIG. 47.

On the 28th. inst. the sun set as usual, and also on March 1st. The weather during the three days of the phenomena was not at all boisterous, nor was there any remarkable change on the two succeeding days, but on the night of March 1st. there was a severe storm of wind and rain from the southeast. When this gale was at its height, the wind suddenly fell but in a few moments sprung up again and blew strongly but not with its previous violence, from the north, and did not continue to blow long. On the evening of March 3rd., the second after the cessation of the storm, a similar phenomenon occurred again at sunset, but this time it was not followed by any marked change in the weather.

During the sixteen days that I passed on Little Cayman during the last half of April, 1888, I saw the sun sink every evening, unobscured by any cloud, into the waters of the Caribbean, and his lower portion was always more or less flattened as he came in close proximity with the water, but I never saw any division as at Way Key.

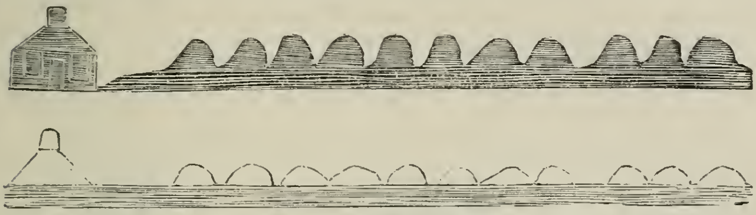


FIG. 48.

On Nov. 27th., 1876, while in the yacht "Nina" then lying in the Cape Fear River just off Smithville, North Carolina, I saw a singular mirage. From where we were anchored we could see the tops of the sand heaps, which were all that remained of the famous Fort Fisher, and the lantern and roof of the lighthouse that stood between it and the north channel of the river. There had been a light southerly wind during the previous night, but this fell towards morning, and by sunrise there was a dead calm, with the water all around as smooth as a mirror. Looking off to the northeast I observed that the whole of Fort Fisher, with the land of the point on which it stood, and the lighthouse was, to all appearances, lifted about twice its former height, but at the same time the mounds of the real fort and roof of the lighthouse could be seen in its original position below, but the shadow was much more distinct than the substance. See Fig. 48, where the lower line of objects given in outline represent the fort and light in its original position, and the upper shaded line, the mirage. The light, in the cut, has been inadvertently placed at the north, or left side of the fort, when it should be on the south, or right side.

This phenomenon occurred about sunrise, and shortly after the wind began to blow strongly from the south-west. It continued to increase in velocity all the morning, and about eleven o'clock I noted that the sky presented a peculiar appearance, being covered with singular star-shaped clouds, About noon the wind was very high. and the rising tide was rushing in with great force. I had been out in a boat on the opposite side of the bay with an assistant, endeavoring to shoot some oyster catchers, when noticing that the water was growing rough, we returned and encountered some huge waves when crossing the harbor. Shortly after we had regained the yacht, the storm rose to a perfect gale, and by twelve o'clock we dragged our light anchor, and were obliged to put down a heavier one to prevent fouling with vessels astern. Other crafts also dragged during the most furious portion of the gale, but without doing any damage. The wind continued high till late at night. There was a lurid overcasting in the sky to the southwest, but the sunset was purple and gold. By midnight the wind had fallen, and had shifted to the northeast and continued to blow from this quarter all day, but was not very high. At night however, it again increased in violence accompanied by a high sea. On the 29th. inst. the storm continued, with rain, but by the 30th, although cloudy in the morning, the wind had fallen and changed to the northward.

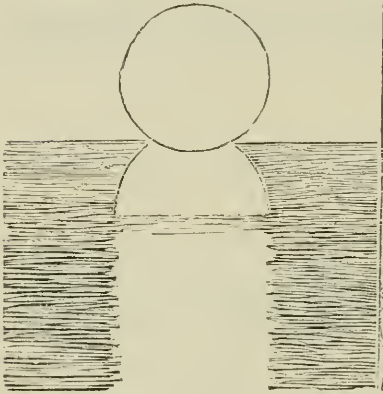


Fig. 49.

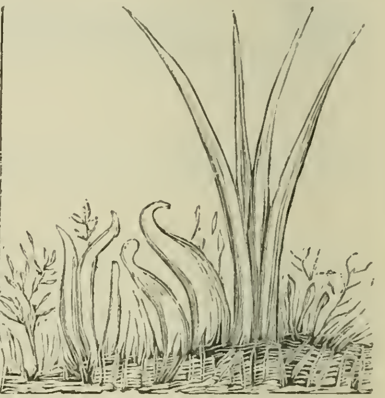


Fig. 50.

It was noticeable just preceding this gale that the shore birds were remarkably stupid, appearing as if dazed.

When on Bird Rock, in the Gulf of St. Lawrence, early in July, 1873, I observed a singular mirage of the neighboring islands. Usually the only land visible from Bird Rock is Byron Island, some ten miles to the southward, and sometimes, the other more northern of the Magdalens, but on this particular day, also early in the morning, I saw distinctly Anticosta to the northwest, Newfoundland to the eastward, and St. Pierre to the southward.

This phenomenon was followed by a storm, so violent that the great waves which were hurled against the rock made it tremble from base to summit, and sent the spray over the top of the lighthouse, although it was elevated two hundred feet above the sea level.

On the night of the 2d. of Dec. following the storm at Smithville, North Carolina, I observed a singular appearance of the moon, when rising out of the water to the eastward. There was seemingly a half moon remaining in the water at the end of the pathway of light, that the moon always sheds upon the surface, with its upper disk in contact with the lower of the true moon. This phenomenon lasted only a few moments. See Fig. 48.

This moon mirage was followed by very cold weather for that section, the thermometer falling to 18 degrees above zero. That morning I found some singular, plant shaped frost crystals in the pine woods. These crystals were six inches high and three quarters of an inch in diameter, with the terminations curled backward, giving them a singularly leaf like appearance, while their resemblance to plants was heightened by the fact that they grew in clusters. See Fig. 49, the longer leaves to the right are those of a species of lily, while to the left of them are the frost crystals. They were to be found in numbers, and their origin was probably due to the sudden cold encountering a moisture laden atmosphere.

On Nov. 27th., 1887, I was on a small schooner that I had chartered, lying in Fresh Creek, Andros, Bahamas. There had been a continous gale blowing for five days with the wind northeast, and on the night of this day the wind still continued high, with frequent thunder showers. During the intervals between the showers, the moon, then full, or nearly so, shone out between the rifts in the clouds. About ten o'clock I went on deck just after the passage of a shower, to watch the dark masses of clouds that were rushing wildly across the face of the moon. A little rain fell from some of the larger portions of clouds, and it was just as one of these showers had passed, allowing the moon to shine out with sudden splendor, that I saw a distinct rainbow spanning the creek to the westward, the moon then having attained an altitude of about forty-five degrees from the eastern horizon. The bow was, as I have said, distinct but pale, yet some of the brighter colors were visible. It lasted only a few moments then disappeared, but the effect of its sudden appearance amid the flying masses of dark clouds, and in the very midst, as it were, of the howling gale, was weird and ghostly in the extreme. On Dec. 1st. I saw another bow by moonlight.

Both of these bows instead of indicating pleasant weather, appeared in the midst of one of the longest gales with which the Bahamas had been visited for years. Practically, the storm began on Nov. 27th., but was preceded by huge waves as early as the 25th , making Nassau bar impassable for vessels, and the wind continued high, till the night of the fourth of December. I was told at Fresh Creek that there had never been such a high sea known there before, at all events, it broke in one continuous line of foam over the Goat Keys that form part of the reef outside the mouth of the creek, and the water within rose at least ten feet higher than during ordinary weather.

NOTES ON THE SOUTHWARD MIGRATION OF THE WHITE-BELLIED SWALLOW, HIRUNDO BICOLOR.

The following notes on the southward migration of the White-bellied Swallow were made under peculiarly favorable circumstances, and are of interest on this account. In the autumn of 1876, I took a voyage in the yacht "Nina" from Woods Holl, Mass., to Jacksonville, Florida. We sailed from Woods Holl on October 14th., and arrived in the St. Johns River, Florida, on Jan. 10th., 1877. During this leisure voyage which was made as far as possible along the inside passages, viz., the bays, sounds, and rivers, which are connected by a system of canals, I had an excellent opportunity of noting the southward movements of the birds, and the Swallow mentioned was one that received considerable attention.

On the 10th. and 11th. of October, I found the White-bellied Swallows abundant at Woods Holl. On the morning of the 12th. instant a large flock was seen flying about in a compact mass over the hills, after which they disappeared.

While we were lying at New Bedford on the 15th., we had a snowstorm, lasting all the morning with a cold northwest wind, and the weather was very cold for the following three days, thus I felt certain that we were behind all of the swallows.

At Perth Amboy, New Jersey, on Oct. 25th., saw a few White-bellies, evidently the rear guard of the general migration. The weather at this time was moderately warm, but on the 27th.. when we were in the

Delaware River we experienced another cold wave, the wind being northwest, and quite high.

On Nov. 12th. in Pamlico Sound, North Carolina, we again came up with the Swallows, here we saw a large flock flying about the marshes of the western side. They were still about on the following day.

Dec. 29th., at St. Catherine's Sound, Georgia, I shot a White-bellied Swallow out of a large flock that were flying over the marshes. The next day was very cold, there having been a hard frost during the night, consequently the Swallows disappeared.

Jan. 4th., we again caught up with the Swallows at St. Simon's Island, Georgia, but there were only a few specimens.

On Jan. 7th., when near the St. Johns River we saw the Swallows once more, and being now in the milder climate of Florida, saw them nearly every day. They are constantly resident in Florida during winters, but wander about the state in large flocks, apparently visiting various portions, but never remain long in one place north of the middle section. In the vicinity of Indian River they may be seen every day. It is probable that this portion of Florida, and southward, is the winter home of the White-bellied Swallows, and that during warm spells some wander further north.

By the foregoing notes it will be seen that this species of Swallow keeps only just so far beyond the reach of cold as will warrant it finding a sufficient supply of food, although in autumn the White-bellied Swallows eat a large number of the fruit of the bayberry, at least while they are in Massachusetts, yet it is quite probable that they cannot subsist on this diet long, but must also obtain some insects. That they do subsist for a time upon bayberries after the frosts have destroyed many of the insects which form their habitual means of sustenance, shows that they migrate with considerable reluctance. Thus, while it is probable that the White-bellied Swallows cannot endure any great degree of cold, they certainly do remain in the north long after frosts, and thus their migrations are governed, in a great measure, by the food supply.

MONOGRAPH OF THE GENUS STROPHIA.

(Continued from Page 135.)

24. STROPHIA UVA Linn.

Grape Strophia.

Plate XVI. 1 & 1a: Fig., 51, shell.

Turvo uva Linn. Syst. Nat., XIII ed.,p. 364, No.68

DESCRIPTION.

Sp. Ch. Size, medium. Shell, not heavy. Striations, present. Teeth, two, very short and both close together. Whirls, 11, very narrow.

Form of shell, short and oval, with the greatest diameter at the third and fourth whirls, while the first and fifth are about equal in diameter, from the fifth whirl the shell narrows gradually to the rounded apex. The whirls, excepting the first, are narrow, the second, third, and fourth being of about the same width, while these and the fifth, taken together equal the first. The striations are quite prominent. Fig. 51, a, (where they are enlarged) 22 on the first whirl; they are very regularly arranged in lines, and are about an equal distance apart, the interspaces being a little wider than the prominences. The striations are smooth and rounded on top.

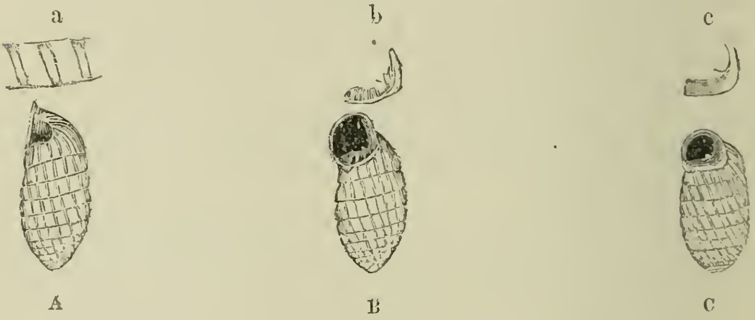


Fig. 51.

Aperture, small and contracted, measuring a little less within, than at the entrance. Lower tooth, small, not over .02 high by .05 long, and is placed well over to the left of the center, and just above it, not over .02 distant, to the very short upper tooth, see ib., b, for an enlarged cut of these remarkable teeth.

Margin, not produced forward quite as far as the diameter of the shell, is slightly inclined to the right, is thin, measuring only about .02, and the outer posterior portion is rolled slightly downward, and produced into a thin edge. The frontal bar is prominent enough to interrupt the striations.

Color of shell, externally white, polished and shining internally and on the striations, within the aperture there is a faint tinging of yellowish.

DIMENSIONS.

Size of figured specimen, .87 by .37. Largest specimen, .90 by .40; .75 by .35. Greatest diameter, .40, smallest, .35. Longest specimen, .90, shortest, .75.

OBSERVATIONS.

Among the shells of this singular species, that have passed through my hands there is considerable variation in form, teeth, and in number of striations. The widest departure from the types in regard to form is one in which the first four whirls are of the same diameter, then the shell tapers to a rather acute point. A second form has the first four whirls of the same diameter and with the apex rounded as in the type. Neither of these forms have the bulging appearance so characteristic of the species. It is remarkable that of two cylindrical shells before me one has one tooth only, and the other has none. This and the pointed form may each constitute a species, as it is possible that these characters are constant, and that the shells which are so marked come from different locations. The specimen that I have figured came from the collection of the Boston Society of Natural History and was labeled as coming from Curacoa, while others which I have, nearly similar, are labeled as having been collected on Guadaloupe. The one-toothed and toothless specimens are simply labeled West Indies. (See Fig 51, c.)

Typical shells of this species may be at once recognized by the narrow aperture, with the teeth close together, thus constituting a group, as noted on page 131, the narrow whirls with their prominent striations, arranged in regular lines, and the peculiar bulging form below the middle of the shell.

HISTORY AND DISTRIBUTION.

This species, although the very oldest described shell of the genus, appears to have been recognized by many conchologists from the first, while nearly all have described it correctly; where a figure has been given it is clearly of this species. I most heartily wish that the status of all of the older described species were as easily established as this. (In this connection see remarks under head of S. mumia.) This is somewhat remarkable, as the description given by Linnaeus most certainly could be applied to almost any of the smaller Strephias with striations, although to few, and not even to this, excepting to the form mentioned, can the term "apatura unidentata" (aperture one-toothed) be applied.

I append Linnaeus' original descriptions, with a translation, and also Sylvanus Hanley's remarks on the type which he has examined in the collection of Linnaeus.

Description of Turbo uva as given in the thirteenth edition of Linnaeus' Systema Naturae, page 3604-3605, No. 68.

"T. testa cancellata ovata obtusa: anfractibus contiguis: striis longitudinalibus imbricatis.

Habitat in mari, Americanum australem, alluente, testa ab 1 1-2 pollicem longa, alba, cincerea aut spadicea, umbillicata, anfractibus circiter 12 primo-triplo majore secundo: sulcis intermediis striis æqualibus, apatura unidentata."

Shell, obtuse oval, whirls close together, striations, longitudinal and overlapping.

Habitat in the ocean of Southern America and in rivers; shell one and one half inches long, white, cincerous, or chestnut, umbilicated, encircled by twelve whirls, the first of which is three times as large as the second. Sutures between the equal striations, aperture one toothed.

Sylvanus Hanley in the Shells of Linnaeus says; "The Pupa uva of Pfeiffer's Monograph alone of the shells in the cabinet of Linnaeus, who has recorded his possession of the species, answers to the definition of this common shell". (Ipsa Linnaei Conchylia. The Shells of Linnaeus, Determined from his Manuscripts and Collection; by Sylvanus Hanley. London, 1855, page 343.)

25. STROPHIA MUMIA Brug.

Mumia Strophia.

Plate XVI, a, b, c, & Fig. 52, a, b, c, shell.

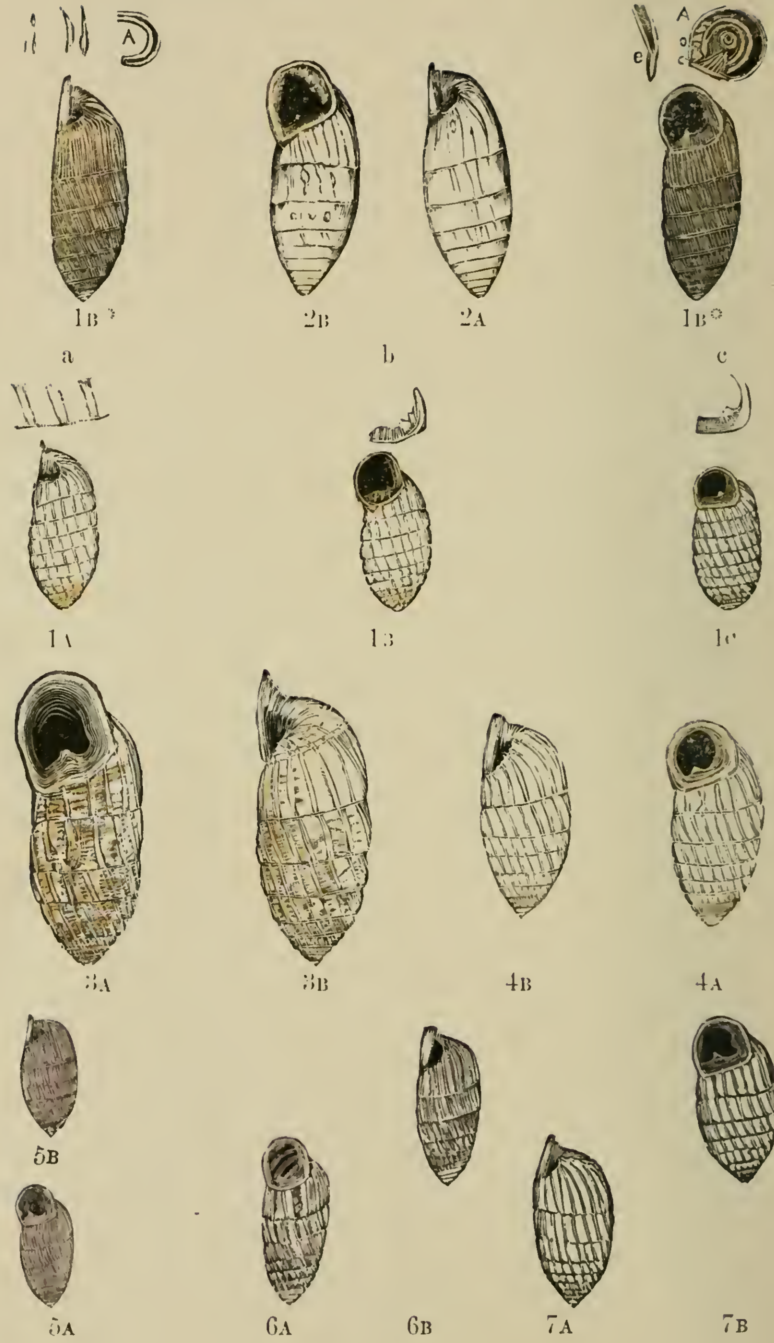
Bulimus mumia Bruguiere, Encyclopedie Methodique; Nat. His. Des Vers, I, page 348, No. 87.

DESCRIPTION.

Sp. Ch. Size, very large. Shell, heavy. Striations, present. Teeth, two, not long nor high. Whirls, 10 to 12.

Form of shell, cylindrical, with the first three whirls equal in diameter, the fourth is but little smaller, but from this the shell slopes to a point, forming an angle of about 65 degrees. The first whirl is long, occupying almost one half of the length of the shell; the second whirl is as wide as the third and one half of the fourth, the fourth is equal in width to the next two lower, and each successive whirl is of the same proportionate width. The striations are not numerous, (20 to the first whirl,) they are not very prominent, are irregular in form, and not ar-

PLATE XVI.



EXPLANATION OF FIGURES ON PLATE XVI.

1B*. Strophia dallii, right hand figure, front view of type; left, right view of same.

2B. Strophia maritima, front view; 2A, right side of same.

1A. Strophia uva, right side; 1B, front of same; 1C, another form of same species.

3A. Strophia mumia, front; 3B, right side of same.

4A. Strophia brownei, front view of type; 4B, right side of same.

5A. Strophia viola, front view of type; 5B, right side of same.

6A. Strophia orbicularia, front view; 6B, right side of same.

7A. Strophia glans, right side; 7B, front of same.

ranged in lines, are only very slightly inclined from right to left, and the interspsces are about twice as wide as the prominences. The striations are very slightly furrowed on top, but the edges are round and polished.

The aperture is very large and open, measuring considerable more within than at the entrance. The lower tooth is proportionally short, being about .12 long, and is not high, about .04, and its position is central; the upper is situated about .10 above it, and is represented by a mere protuberance on the column.

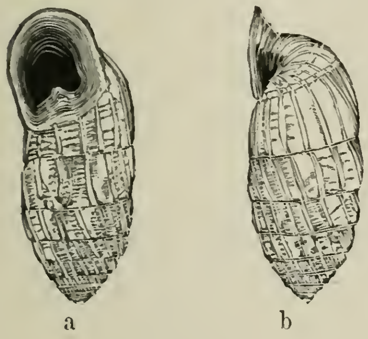


Fig. 52.

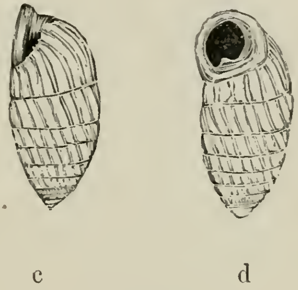


Fig. 53.

Margin not produced forward beyond the diameter of the shell, and is inclined very much to the left, far beyond the side, it is considerably thickened but becomes thinner on the edge, which is rolled backward considerably, producing a very flanging mouth, being in fact nearly bell-shaped. The frontal bar is not very prominent and the striations are not interrupted, indeed the whole interior of the shell is roughened with depressions which correspond to the external prominences.

Color of shell externally, mixed white and pale chestnut, both colors being arranged in transverse zigzag markings that are often arrow-shaped. On the body of the shell the colors are in about equal parts, but on the back of the upper whirl, the white predominates, almost to the exclusion of the chestnut. Within, the color is pale orange, fading gradually into white on the outer portion of the margin.

DIMENSIONS.

Size of specimen figured, 1.58 by .57. Largest specimen, 1.75 by 60; smallest, 1.25 by .45. Greatest diameter .60; smallest, .45. Longest specimen, 1.75; shortest, 1.25.

OBSERVATIONS.

There is an inclination in this species to become more elongated and cylindrical, thus in some specimens the first four whirls are of the same diameter. There is also some variation in color, but the characteristic zigzag markings in chestnut are always present.

The small-sized specimen given under head of dimensions may constitute a separate species as it is a much thinner shell, with a less open mouth, and a much narrower margin. The markings are also more distinct, the chestnut being deeper in shade.

This species may be considered as the type of a group of shells, most of which I believe inhabit Cuba, and which have the peculiar flanging mouth and zigzag markings. The markings are confined to a very limited number of species, but the open mouth is peculiar to the greater number of Cuban Strophias.

This shell may be at once recognized by the large size, flanging margin, irregularly formed, widely separated striations, which occupy all of the whirls, excepting the two lowest, and the zigzag markings which give the shell a rougher appearance than it really presents upon close examination.

HISTORY AND DISTRIBUTION.

I have said under head of the preceding species, that it is fortunate that conchologists are all, or nearly all, agreed upon just what Strophia uva is, for many of the older described species of the genus are far from being in a similar condition. The species in hand presents one of those very problems which has given me a great deal of trouble to settle.

The difficulty can be stated in a few words. In 1792, Bruguiere described in the Encyclopedie Methodique, among other shells, some of them Strophias, a species which he calls Bulimus mumia, most evidently a Strophia, although he considered it a marine shell. Now his description is so general that it may be applied to almost any species of Strophia having a flanging margin, more especially to several Cuban species. In proof of this we have only to glance at the description and figures of those authors who have described this species since, scarcely any two have interpreted Bruguiere's description in the same way, or in other words, scarcely any two have applied his name to the same species of shell.

Such being the facts of the case, as I shall endeavor to show later in this article, the question comes, to what species of flanging mouthed shell is the name of mumia to be applied? To show in the outset that Bruguiere's description is far from being detailed enough to clearly define any one species of Strophia, I give it below, first in the original Latin and French, then translated.

The description is from the Encyclopedic Methodique: His. Nat. Des Vars. I, page 348, No. 87.

T. subcylindrica, oblique sulcata, apetura semi-ovata, bidentata. fulva.

Celle-ci est marine & distincte de celle qui suit, par son epaisseur. par son volume, comme par la couleur de son ouverture & par les deux dents dont elle est armee. Elle a sur une longueur de dix-sept lignes, un demiponce de diametre & environ douze tours. Sa forme est cylindrique, mais le cote de la spire est termine en toupie, & son bout est moins. obtus que dans le Bulime fuseau: le retrecissement de cette extremite ne commence a devenir sensible que vers le cinquieme tour & presque aux deux tiers de sa longueur. La superfice des spires est presque plate & garnie de cotes, arrondies obliques, qui sont separees les unes des autres par des interstices a peu-pres egaux. Les sutures sont simples. plus profondes que dans l'espece precedente, excepte sur les cinq ou six derniers tours du sommet. L'ouverture ne differe de celle du Bulime fuseau qu' en ce qu'elle a un peu moins de longueur & un peu plus de largeur que dans cette espece: sa levre droite est epaisse & repliee a l'exterieur en guise de bourrelet, la gauche est situee comme dans la precedente & collee sur la convexite du second tour: elle offre dans l'interieur. un pli semblable, dont la grosseur est proportionnee a celle de la coquille: on voit un second pli moins eleve que la premier dans le fond de l'ouverture a la base de la columelle, qui semble dependre de la profondeur de l'ombilic. Celui-ci est situee comme dans l'espece precedente, mais il est plus ouvert & meme plus profond.

Cette a coquelle est blanche a l'exterieur, fauve ou rousse dans l'ouverture & sur les bords des levres, & rougeatre vers sommet de la spire; elle est marine & de l Ocean Americain.

Translated, reads as follow. Shell sub-cylindrical. sutures oblique, aperture semi-oval, two-toothed, yellow.

The latter is marine, and distinct from the one that follows, by its breadth, by its bulk, as by the color of its opening and by the two teeth with which it is provided. It is about 17 lines (about 1.50) in length. and one half inch in diameter and has about twelve whirls. The form is cylindrical but the end of the spire is in the shape of a top, and its tip is less obtuse than in the spindle bulime. The narrowing of this extremity becomes noticeable only about the fifth whirl, and at nearly two thirds its (the shell's) length. The surface of the cone is almost flat and provided with ribs, rounded and oblique, which are separated by nearly equal spaces. The sutures are single, deeper than in the preceding species, except about the last five or six whirls of the top. The opening differs from that of the Bulimus fuscis only in that it is a little shorter and a little wider than in that species: its right lip is thick and turned up at the extremity like a tumbling cap, the left is situated as in the preceding (species) and is placed (stuck) on the convexity of second whirl. It presents in the interior a similar fold, whose size is proportional to that of the shell. There is a second fold lower than the first in the bottom of the opening at the base of the collumella which seems to hang from the depths of the umbilicus. The latter is situated as in the preceding species but is more open, and also deeper. This shell is white on the outside, reddish, or red, in the opening and on the edge of the lips, and reddish about the top of the cone, it is marine, and is found in American Seas.

It is evident from the foregoing description that the author had some species of Strophia that had two teeth, that is, two prominent teeth, as in the majority of speies the of genus, not as in uva, that was about an inch and a half long, by a half inch in diameter. that was cylindrical in form, but narrowed to a point from the fifth whirl. it was also provided with striations (cotes) which are oblique and separated by about equal spaces, the margin is flanging, resembling a tumbling cap, it is white externally, but reddish in the opening and on the margin.

Such in brief are the only characters which will be of any service in determining the species that the author had in hand, but unfortunatelythese will answer for several Cuban shells.

As remarked, authors in endeavoring to fit this too general description to some species of Strophia have failed to agree. A hasty review of some of the principal works on the genus will serve to illustrate just how widely authors have disagreed.

Strophia mumia was described in 1792, but no figure was given of it at that time, and the first one of a shell intended to represent this species is an Illustrated Introduction to Lemarke's Conchology, by Edmund A. Crouch, London, 1827, Plate XV, No. 2. Here is given an unmistakable portrate of the species that I have named S. cinerea, a shell, in which the development of the margin is reduced to nearly or quite a minimum, in place of being large and flanging. It is not white without nor reddish within, but the other characters given by Bruguiere might apply to this shell yet they are really generic. and will also apply to any Strophia with striations.

Next we turn to the Histore Naturelle Generale et Particulere des Mollusques, par D. De Ferussac et, G. P. Deshayes, Paris, 1820-1851, Vol. II, Plate 153, Fig. 4, 5, & 6, where is given figures of what the authors consider mumia. No. 4 is a mottled shell, but too slender and pointed for typical mumia, and is what is oftenest given as S. crysalis, both in figures and in collections, while 5 & 6 are white shells of quite a different species. On page 208 of this work we find Pfeiffer's description as given in his Monograph copied in full.

Again in Systematisches Conchylien-Cabinet von Martini und Chemintz by H. C. Kuester, Nuernberga, 1852, Plate I, Figs. 1 & 2 we find the pointed form of S. uva, mentioned on page 175 of this work, given as mumia, while on the same plate unmistakable figures of typical mumia are labeled as chrysalis. Then on Plate XV is given another figure of what is considered also as mumia, but which looks quite like my S. alba. On page 10 we also find an exact copy of Pfeiffer's description.

In the comparatively recent Conchologia Iconica or the Illustrations of the Shells of Molluscous animals. by Lovell Augustus Reeve, London, 1878, on Plate I, 3a, we find for the first time the shell that I have also considered mumia figured, but 3b on the same plate represents quite a different shell, probably S. infanda or an allied species.

In the face of these various opinions regarding the status of a given species, it becomes somewhat difficult to decide as to what course to pursue. At first I was inclined to take the earliest recognizable figure and call the species that it represented mumia, but as shown, this is Crouch's figure of S. cinerea, a shell so widely different from that which Bruguiere had in hand when he wrote his description, and which I do not remember to have seen in any collection labeled as mumia, that I have decided not to adopt such a rule. In fact I do not see as any fixed rule can be made in regard to establishing the status of the older described species of Strophia where no recognizable figure accompanies the description. In this case I have followed what may be called universal usage, that is I have taken a species of shell which embraces all of the characters given in the original description, and which I have found in most collections labeled as mumia, and have considered it as the type of mumia. and I can see no good reason why conchologists should not uphold me in this decision.

I have access to most, if not all, of the literature on Strophia, while I have also seen some of the best collections, and shall use every available means to unravel the tangle in which many species of this genus are now involved, but it will be at once seen by any one who attempts to identify species from the short, too often obscure, Latin descriptions which are unaccompanied by good figures, that it is exceedingly difficult to determine what species the author of such descriptions had in hand when he wrote them. One has only to glance at the figures of Ferussac and Kuester cited in the foregoing article to see that both have not only figured shells quite different from mumia, but that they have each given different species from one another, and to crown all, both figure two or more species as one, yet both had Pfeiffer's description to work with, for they have copied it, as before mentioned.

The shells of this species which I have seen have simply been labeled as coming from Cuba.

STROPHIA BROWNEI Novo.

Browne's Strophia.

Plate XVI, 4, 4A, & Fig. 53, shell.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, heavy and robust. Striations present, but not prominent. Examined 25 specimens.

Form of shell, oval, the greatest diameter being on the second whirl, the first is very little smaller, and the third but slightly smaller than this, and from this last mentioned whirl the shell tapers to a rather blunt point, forming an angle of about 60 degrees. The striations are numerous, 20 on the first whirl, and occupy all but the two lowest whirls, are regular, but are not arranged in lines and are but slightly inclined from right to left. The striations are slightly furrowed on top but the edges are smooth and rounded, they are not widely separated, the depressions being about equal in width to the prominences.

The aperture is quite small and contracts rapidly, measuring somewhat less within than at the entrance, and the teeth are situated some distance inside the opening. The lower is short, about .05 and only .03 high, it is placed about midway between the two walls, while the upper, which is only represented by a protuberance is placed considerably above it.

The margin is not produced forward beyond the diameter of the shell, is considerably thickened, measuring about .05, and the posterior portion is provided with a thin, though not very prominent edge. The frontal bar is very prominent and completely interrupts the striations.

Color of shell, white externally, tinged with yellowish within the aperture.

DIMENSIONS.

Size of type, 1.10 by .50. Largest specimen, 1.16 by .52; smallest, .90 by .49. Greatest diameter, .52; smallest, .49. Longest specimen, 1.15; shortest, .90.

OBSERVATIONS.

Beyond question this species is related to S. alba, but whether as a remote progenitor or as an offspring it is difficult to state, although I am inclined to think the former hypothesis the more correct one, for my studies of this genus lead me to believe that the lighter, thinner shelled species are the most recent. At all events S. brownei is distinct enough from alba at present. The shell is much smaller, thicker, with a considerably thickened margin with decided striations extending to the seventh whirl. There is a form of Browne's Strophia which has more widely separated striations than in the type, 19 or 20 to the first whirl, and these are wider on top. This form bears a strong external resemblance to S. fusca, even to a brownish tinging between the striations, but a glance at the teeth will serve to separate the two species, brownei having a short, inconspicuous tooth, while fusca has the long tooth so characteristic of the Cayman species, in short, the two shells belong to different groups. (See remarks on page 130.) There is a shell on New Providence of which I have seen two or three specimens only, which may prove identical with this, but I shall have occasion to speak of this later.

Strophia brownei may be distinguished then from all others by the thickened margin with contracted opening, with the short teeth placed well within it, and oval form.

I have named this species for my friend Mr. Frank C. Browne of Framingham, who has evinced a great interest in my work on the genus Strophia, and to whom I am greatly indebted for the use of many specimens. It was in his cabinet that I saw a shell that called my attention to this species.

DISTRIBUTIONS AND HABITS.

Strophia brownei is found on Rum Key near the north side, and occurs among low shrubbery, where it appears to be not uncommon. While crossing the key on the day that I visited Hartford Cave, mentioned in a preceding article, I saw numbers as I rode along the road and fully intended cellecting them as I returned, but when I passed the place in the evening, darkness prevented me from securing any, and I did not have an opportunity of visiting the locality again.

(CONTINUED.)

PBLiCATIONS RECEIVED.

A Rambler's Lease. By Bradford Torrey. Boston and New York, Houghton, Miflin and Company, 1889.

This is a charming book from beginning to end, for with magic pen the author opens wide the gates which lead into the enchanting realms of Nature, and bids his readers follow him while he converses most pleasantly of the wonders which are there. Wonders, which as Mr. Torrey shows, are in open sight, yet are seen by a very few, but under the skilful guidance of our talented author, he must be dull indeed who cannot appreciate the beauties which lie all about us. One of the most noteworthy things about this work is the fact that Mr. Torrey teaches, that much can be done toward advancing our knowledge of animals without taking their lives, This is especially shown in regard to what one cannot fail to see are his favorites among his many friends, namely, the birds, and after reading some of his chapters in which he has given an account of his feathered acquaintances, those of us who can count our avian victims by the thousands, feel fairly ashamed of our murderous exploits. I for one can say that I shall never again take the nest of a vireo of any species with any degree of satisfaction, for I shall never forget Mr. Torrey's story of his pet, blue-headed vireos,

I read this little volume with great interest and re-read it with greater pleasure every time I take it in hand, and most heartily wish that this book could be in the possession of all of our young people. Beyond all doubt the study of Natural History is elevating to a high degree, and in this work the subject is presented so pleasingly that it cannot fail to awaken the interest of even the most apathetic.

Deep Sea Mollusks and the Conditions under which they Exist. By William Healy Dall. Authors extra from the proceedings of the Biological Society of Washington, D. C., Vol. V, 1888-1890.

In this, one of the most interesting and valuable papers upon zoology that I have ever read, the author gives with sufficient detail the changes which mollusks, that inhabit the deepest portions of the ocean have undergonein order to exist. To those who have never investigated the matter, it is difficult to understand how different the environment in these profound depths is from that in the sea nearer the surface. At 2,000 fathoms (12,000 feet) under the ocean no ray of light can penetrate, the water is icy cold but above all the pressure is so great that it "may amount to several tons to the square inch." Consequently all tissue of animals living at such depths must be so loosely constructed as to allow the water to permeate every part. Dr. Dall finds that "The looseness of tissue necessary to such permeation is conspicuous in abyssal animals, whose flabby and gelatinous appearance when they reach the surface is notorious. Under the great pressure of the deeps it is quite conceivable that each of these loose and half dissolving muscles may be compressed and reduced to a condition resembling steel wire."

Dr. Dall has arrived at the conclusion that the deep sea mollusks do not prey upon one another, but feed upon the remains of the various animals which dwell in the waters above them and which are constantly raining down upon them, "Hence in many regions of the sea bottom the resident fauna have, as it were, only to lie still and hold their mouths open." The colors of these mollusks of the deeps is given as pink or reddish straw color, salmon color, and various shades of brown. Heavy knobs and spines found on shallow water species, as in Murices, are represented in their deep water congeners by thin spines and slender processes. On the other hand, sculpture on deep water shells is of a kind which serves to strengthen the structure. In conclusion a table of the number of species which occur in the abyssal fauna compared with the more shallow water forms is given. The deep sea shells, including Brachipods, as far as known, consist of one hundred and twenty nine species, representatives of forty-seven families and sixty-five genera.

THE ENGLISH SPARROW, PASSER DOMESTICUS, IN NORTH AMERICA, ESPECIALLY IN ITS RELATIONS TO AGRICULTURE. Prepared under the direction of DR. C. HART MERRIAM, Ornithologist, by WALTER B. BARROWS, Assistant Ornithologist. Bulletin No. 1 of the United States Department of Agriculture. Received from J. M. Rust, Secretary of Agriculture.

In this volume of over four hundred pages, an exhaustive account of the English Sparrow in North America is given. Its importation, spread, increase, and the checks to prevent its further spread, are treated at length in the first Section, while Section two is made up of evidence received by the department, and gathered from various sources where published accounts of the Sparrow have been given, both in Europe and America, as to the opinion of observers relative to the probable injurious or beneficial effects of the Sparrow in regard to agricultural interests. The following is a summary of the replies received by the department to the various questions.

Injury to buds, blossoms, and foliage of trees and vines. Five hundred and eighty-four replies received; of these, seven were favorable to the Sparrow, two hundred and thirteen unfavorable, and fifteen, partly favorable and partly unfavorable.

Injury to fruits, garden seeds and vegetables. Received seven hundred and eighty-eight replies. Favorable, twenty-four: unfavorable. three hundred and eighty-four; partly favorable and partly unfavorable, thirty-seven.

Injury to grain crops. Received seven hundred and fifty replies. Favorable, two; unfavorable four hundred and thirty one; partly favorable and partly unfavorable, five.

Out of five hundred and ninety-one observers in regard to the insect eating proclivities of the Sparrow, the majority decided that it eats insects only when driven to such a diet from necessity, or at best when feeding its young.

Thus it will be seen that the preponderance of evidence is unfavorable to the Sparrow, hence it becomes a question of vital importance to the agriculturists, whether or not legislative action be taken to at least keep these pests from further increase.

ON A METHOD OF DEFENSE AMONG CERTAIN MEDUSÆ. BY J. WALTER FEWKES. Authors extra from the Proceedings of the Boston Society of Natural History, Vol. XXIV, 1889.

In this highly interesting paper, Dr. Fewkes has given us one of the results of his well-known careful studies among the Medusæ. He has found that in one or two genera of the Siphonophores, a few species exhibit what he considers may possibly be a new method of defense, which is that of discoloring the water around them, by discharging colored pigments from certain chromatic cells on the bracts, and that these cells bear relationship and perhaps are homologous with the nematocysts in other genera of the groups in which they exist.

This pigment, which is always of a bright color, may serve to darken the water enabling the Medusa to conceal itself from its foes, or may warn away its enemies, or bewilder its prey, or be of a poisonous nature, fatal to its prey or foes.

INDEX.

Agraulis insularis, 89
  vanillæ, 90
American barn owl, 165
  woodcock, 103
Alsophis fuscicauda, 156
Ameiva maynardii, 110
  thoracica 111
Ampelis garrulis, 101
An eel (Rhinomuræna quæsita) from the Marshall Islands, by Samuel Garman. (Noticed.) 49
Ani, 166
Anisomorpha buprestoides, 31
Anolis luteosignifer, 115
  maynardii, 115
  ordinatus, 113
A Rambler's Lease. By Bradford Torrey, (Noticed.) 198
Aristelliger præsignis, 106
Arrow-headed warbler of Jamaica, 136
Audubon's Shearwater, 144
Bahama woodstar, 171
Birds of the West Indies. By Charles B. Cory, (Noticed.) 97
Black Tern, 99
Bohemian Waxwing, 101
Bonasa umbellus, 159
Brown globefinger, 108
Brown strophia, 77
Browne's strophia, 196
Brown-tailed snake, 156
Buteo borealis, 39
Cathartes aura, 40
Chapman, Frank M., notice of his paper on some new species of white-footed mice, a new cotton rat and on the habits of the round-tailed muskrat, 98
Chelonia midas, 158
Clouded iguana, 37, 154
Coccothraustes vespertina, 194
Common Gannet, 143
Common Strophia, 22
Cory's gannet, 40, 51, 142
Cory's rail, 39
Croaking lizard, 112
Crocodilus, 156
Crotophaga ani, 166
Curl-tailed lizard, 109
Cyclura nubila, 37, 154
Dall's strophia, 128
Danais berenice, 137
Davidson, J. P., notice of his Birds of Niagara Co. N. Y. 149
Deep sea Mollusks and the Conditions under which they Exist, by William Healy Dall. (Noticed.) 198
Dendroica ignota, 30
Dermochelys coriacea, 156
Description of an apparently new species of warbler. from Jamaica, 30
Description of a new species of butterfly from the West Indies, 8
Description of a New subspecies of Poocætes from

Oregon, By G. S. Miller, Jr. (Noticed.) 49
Description of supposed New Species of Birds from Western North America and Mexico. By William Brewster. (Noticed.) 49
Devil's horse, 31
Diploglossus maculatus, 155
Diseased feet of a Chipping Sparrow, 125
Doricha evelynæ, 171
  lyrura, 176
Dotted globefinger, 108
Dwarf strophia, 27
Eretmochelys imbricata, 158
Evening grosbeak, 164
Evermann, Barton W. Notice of his Birds of Carrol County, Indiana, 98
Falco peregrinus, 40
Fiber zebethicus, 99
Flecked strophia, 75
Florida mottled owl, 163
General habits of strophia, 7
Generic characters of strophia, 3
Genus strophia, 3
Grape strophia, 188
Gray anolis, 115
Gray lizard, 110
Green turtle, 158
Hawksbill turtle, 158
Helmitherus swainsoni, 39
Hirundo serripennis, 162
Hydrochelidon nigra surinamensis, 99
Hyla septentrionalis, 159
Introduction to Monograph of Strophia, 1
Jamaica palm warbler, 30
Killdeer plover, 50
Least tern, 146
Leather-backed turtle, 156
Lined lizard, 111
  strophia, 20
Liocephalus carinatus, 109
  loxogrammus, 110
  schreibersii, 110
Little smooth strophia, 25
Little strophia, 24
Locusts and grasshoppers, 99
Loggerhead turtle, 157
Lyre-tailed humming bird, 176
Man-of-war bird, 140
Maynard's anolis, 115
Maynard's striped lizard, 110
Meteorological phenomena, 182
Mimocichla plumbea, 178
  rubripes, 181
Monograph of the genus strophia, 1, 68, 125, 188
Mumia strophia, 190
Muskrat, Young of, 99
Naked strophia, 29
Nautilus, notice of its appearance, 99
North American Fauna. Nos. 1 & 2 containing papers on rodents. By C. Hart Merriam. (Noticed.) 148
Notes and criticisms, 50, 99, 149
Notes on some Jamaican birds, 39
Notes on the anatomical structure of three species of gannets, 116, 151
Notes on the black snake, Bascanion constrictor, 92
Notes on the habits of some of the West Indian reptiles and batrachians, 106, 154
Notes on the maroon butterfly, Danais berenice, 137
Notes on the southward migration of the white-bellied swallow, Hirundo bicolor, 186
Notes on the young of certain species of birds, 140, 159
On a method of Defence among certain Medusæ. By J. Walter Fewkes. (Noticed.) 200
On Angelopsis and its Relationship to certain Siphonophora taken by the "Challenger." By J. Walter

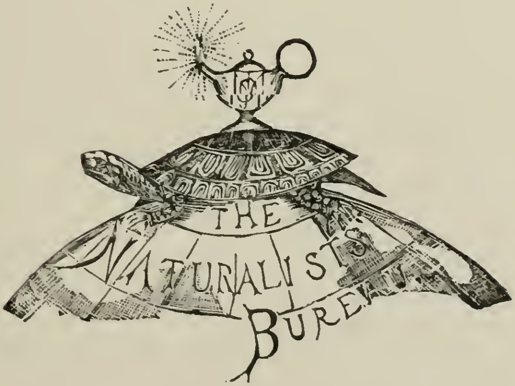
Fewkes. (Noticed.) 147
On the Evolution of the Rattlesnake. By Samuel Garman. (Noticed.) 97
On the Lateral System of Selachia and Holocephala. By Samuel Garman. (Noticed.) 98
On the probable evolution of the Totipalmate birds, pelicans, gannets, etc., 82
Ornamented globefinger. 108
Ornithologist and Oologist. 49
Ortyx virginianus. 161
Painted strophia. 18
Pallid strophia. 70
Peculiar structure of the cœcum of a leaf eating lizard. Cyclura nubila. 37
Pictured strophia. 17
Philonela minor. 103
Phœnicopterus ruber. 166
Plumbeous thrush. 178
Pointed strophia. 15
Prefatory. i
Publications received. 48. 97 147. 198.
Puffinus auduboni. 144
Quail. 161
Ragged strophia. 10
Red-legged thrush. 181
Rallus coryi. 39
Red-tailed hawk. 39
Reptiles and Batrachians from the Caymans and the Bahamas. By Samuel Garman. (Noticed.) 48
Riccord's hummingbird. 177
Ridged strophia. 71
Rough-skinned globefinger, 107
Rough-winged swallow. 162
Ruffed grouse. 159
Schreiber's lizard. 110
Scops asio floridanus. 163
Sea-side strophia. 127
Second Supplement to the list of Coleoptera of North America, north of Mexico. By Samuel Henshaw. (Noticed.) 147
Shining strophia. 73
Singular cause of the death of a white-bellied nuthatch. 124
Singular effects produced by the bite of a short-tailed shrew, Blarina brevicauda. 57
Small rough strophia. 13
Smooth strophia. 12
Some inscriptions found in Hartford Cave. Bahamas, 167
Sound-producing organs of birds, 101, 164
Sphærodactylus argivus. 108
asper, 107
corticolus. 108
decortatus. 108
Sporadinus riccordii. 177
Spotted skink, 155
Sterna antillarum. 146
Strix americana. 165
Strophia acuta. 15
alba, 74
brownei, 196
copia. 22
copia, jaws of, 4
dallii. 128
festiva, 17
fusca, 77
glabra. 25
ianthina. 69
incana. 78
inflata, 126
intermedia. 13
lentiginosa, 75
levigata. 12
lineota. 20
maritima. 127

Strophia nana, 27
  nana, jaws of, 4
  nitela, 73
  nuda, 29
  mumia, 190
  pallida, 70
  pannosa, 10
  pannosa, jaws of, 4
  parva, 24
  perplexa, 71
  picta, 18
Sula bassana, 143
  coryi, 40, 51 142
Swainson's warbler, 39
Swolen strophia, 126
Tachypetes aquila, 140
Thallossochelys caouana, 157
The defensive glands of a species of phasma, Anisomorpha buprestoides, from Florida, 31
The English sparrow. Passer domesticus in North America, especially in relation to Agriculture. By Walter E. Barrows. (Noticed.) 199
The nictitating membrane and chrystalline lens in the mottled owl, 136
The sterno-treacheales as a vocal muscle, 35
The vocal organs of the American bittern, Botaurus, lentiginosus, 59
Turkey buzzard, 40
Violaceous strophia, 69
Ward, Henry A., notice of his articles on the Patigonians and Fuegians, 149
West Indian silvery butterfly, 89
West Indian tree frog, 159
White strophia, 74
Wood slave, 10
Xiphocercus valenciennii, 112

CONTRIBUTIONS TO SCIENCE

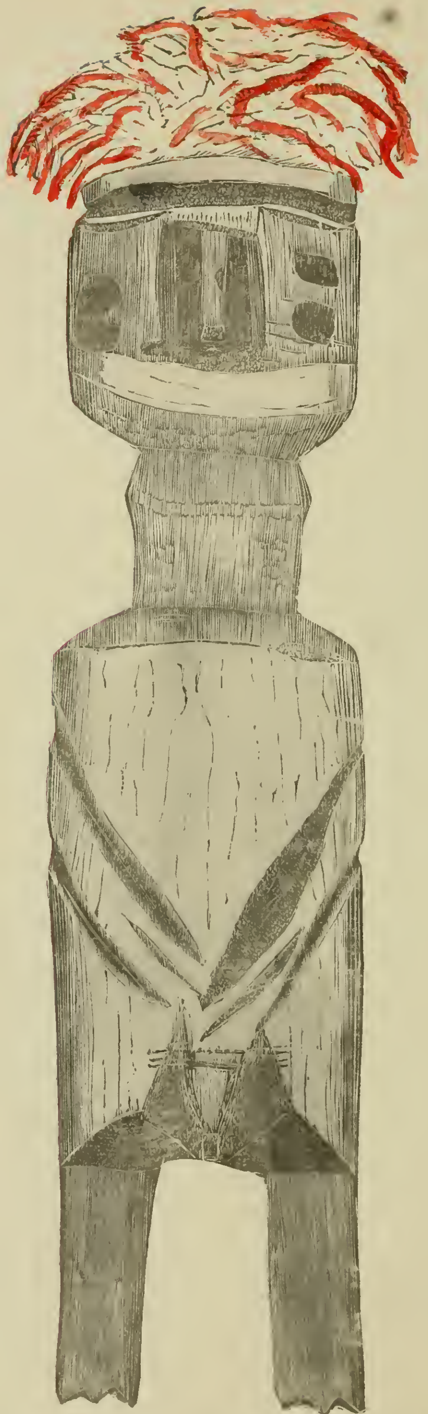
BY
CHARLES J. MAYNARD.

VOLUME II. 1894.



NEWTONVILLE, MASS.:

PLATE I.



Field Fetich. found near Nassau. April. 1884.

CONTRIBUTIONS TO SCIENCE.

BY

CHARLES J. MAYNARD.

Volume Two. November, 1893.

FOLK LORE AMONG THE WEST INDIANS.

The following account is derived from notes and observations taken in the West Indies, during two visits which I made there: one to the Bahamas in 1884, another in the winter and spring of 1887–88, when I took an extended trip to the Bahamas, and passed south to Jamaica, and westward to the smaller Caymans; and to the Bahamas in 1893.

The lower classes among the natives of the Bahamas, may be divided into two rather distinct grades; the colored or mixed race, and the full blooded negroes. The first are rather in advance of the other in some respects: this is especially true of the younger generation who are in a measure educated; that is, a portion of them can read and write. The sponging and fishing business of the Bahamas is in the hands of this class. They are indolent to an extreme degree, no "creole," as they call themselves, as distinguishing themselves from the negroes, whom they designate as Africans, was ever known to work when this could be avoided. This people are the descendents of former slaves, mixed with white blood. The whites now intermarry quite freely with them, and consequently the race is growing lighter in color year by year. In fact even now it is quite difficult for a stranger to distinguish some of the creoles from full blooded whites. Most of them bear the surnames of prominent native white families to whom their slave ancestors formerly belonged. It was customary for a slave to bear the name of his master and upon being liberated the creoles still retained these names.

The second race are the true negroes, full blooded Africans and their immediate descendents, the parents having been liberated by British men-of-war from slave vessels, and instead of having been returned to Africa they were left on the Bahamas. I believe that there are two colonies of this race only, and these live on New Providence in two villages, one at Fox Hill, about three miles from Nassau, and another a short distance back of the west end of the city. I found these negroes, who are mainly Congos and neighboring tribes, a quiet, inoffensive people. They display considerable more energy than the creoles, and are mostly engaged in agricultural pursuits, supplying the city of Nassau with vegetables, fruit, etc. They are industrious, and possess a certain shrewdness in conducting sales of their goods which reminds one strongly of New Englanders, and I have often spoken of these negroes as the Yankees of the Bahamas. These people do not as a rule intermarry with either the whites or the creoles, and consequently they are in a great measure isolated, remaining in some ways much as they were when in Africa.

In spite of the fact that the creoles look down upon the negroes, considering themselves above them in the social scale, they have received a decided influence from them, in keeping alive many of the old African superstitions. It is true that the negroes are christianized, and that the creoles are mostly members of the Baptist church, yet both are strong believers in obeahism with all its peculiar practices. To these African superstitions have doubtless been added others, or the old ideas have been changed by the creoles in having been handed down through a long race of slaves. All this makes their peculiar beliefs particularly interesting.

In the following account I shall not attempt to separate the folk lore of the Africans from that of the creoles, as this would be impossible. When we consider that slavery has been abolished in the Bahamas only about sixty years, and that slaves were imported into the islands up to nearly this time, it will be seen that there can be very little difference between races who have both, so recently, received their traditions from the same fountain head.

Obeahism in the Bahamas is beyond doubt, the direct outgrowth of that peculiar propitiatory worship of evil spirits, so long prevalent in Africa, and which is akin to serpent worship. In fact, it is easy to understand that both forms of worship might have their origin in the same manner. A degraded race of people, with their reasoning powers developed to a limited degree only, inhabiting a vast wilderness teeming with wild animals, many of which were harmful to man, and against the inroads of which these simple people had no certain means of defence, must have lived in great terror of them.

When a weak animal is overcome by a stronger, in many cases the conquered endeavors to propitiate the rage of its foe by some submissive act: a little dog for example, will throw itself on its back, when attacked by a larger specimen of its own race, hold up its paws, droop its ears and tail, in short, show by every act in its power that it is submissive to the will of its aggressor; the tern when pursued by the skua, or the fish hawk when attacked by the eagle, if closely pressed will give up their food to a foe against which they have no chance of success by contention; and numberless similar cases might be recorded among animals.

Thus it was that the African, following teachings, which are after all, perhaps instinctive, early learned to propitiate a foe which he could not conquer. Hence we have serpent worship in its various forms. From the worship of tangible beings, as the mind of man expanded, the transition from the real to the imaginary becomes natural; soon the dark woodlands became peopled with supernatural beings, which were as in the ealier stages of all religions, harmful to man; hence arose the necessity of propitiating evil spirits, either by offerings or in some other way. It is easy to see that the religion of the African is a primative form of worship, in which propitiation of the wrath of evil spirits is the only element, as the mind of this people has not advanced enough for the introduction of a more important, beneficent race of supernatural beings.

As previously remarked, undoubtedly, contact with Christianity has had an influence on the religious belief of both races of colored people in the West Indies, yet few of them are Christians in the true sense of the term; they have adopted the superstitions of Christianity, and not the higher, more intellectual portion of the religion; this is utterly beyond them. Just as they endeavored to propitiate an evil spirit in the old days, so now they consider the Divine power as a being whom they hold in awe, and simply obey the injunctions laid down by the church, because if they do not, they will be visited by punishment. To sum up the whole matter, we may say that these people are densely ignorant; the majority never read, because they cannot, therefore they know little or nothing of what goes on in the world outside of their own neighborhood: ignorance and superstition ever go hand in hand, and with the dark races of the Bahamas superstition has become the leading element of their lives.

The idea of propitiation enters into their ordinary conversation. It is usual to hear such an expression as this: "We will go tomorrow, please God." When asked why they use the suffix, they say that unless they do so the Lord will be displeased, and will not grant their wishes. This fear of a higher power, however, singularly has two quite contrary effects upon the colored races of the West Indies; to obey has become instinctive with them; if on the one hand they obey the teachings of their legal rulers only, all goes well, but if on the other hand, they follow the dictates of the priests of their darker religion, the obeah man, mischief often follows. Many of the bloody revolts in these islands can be traced directly to the power which these obeah men hold over the natives: of this and the obeah men I shall speak later. A striking instance of the law abiding habits of the natives, came to my knowledge when I was on Andros Island. This island is inhabited wholly by negroes, who live along the northern and eastern border, their little huts standing almost on the beach. During a rather severe gale which occurred as I was passing over to the island from New Providence, a vessel, laden with American lumber went ashore near the north end of the island, some distance above Fresh Creek. As she could not be got off, both vessel and cargo were sold to a Nassau merchant. Before he could remove the lumber, however, another gale broke up the vessel and the lumber was scattered along the beach, much of it landing at the very doors of the inhabitants; as they were accustomed to regarding drift wood as a legitimate prize, or perhaps being born wreckers, they did not stop to balance very carefully the strict legality of their proceedings, they gathered the lumber together wherever they found it near their houses, and in many cases concealed it in the neighboring thickets. This coming to the ears of the merchant, he appealed to the governor for protection, and a single policeman was detailed for the duty of not only protecting the remaining lumber, but also for bringing the offenders to justice. This single arm of the law, unaided by anything, excepting the fact that he was a representative of the British Government, not only caused all the secreted lumber to be returned, but also, single handed, arrested and brought back with him to Nassau, fifteen or twenty of the offenders. The negroes did not go because they thought they were innocent, and could quite readily prove this upon trial: they went fully expecting to be punished for a crime, yet not one of them offered the slightest resistance, nor attempted to escape. When the facts came to the notice of Governor Blake, however, he dismissed them all, without even a trial.

Obedience is early instilled into children, they are taught not only to obey their parents, but also all of their relatives who are older than they, also any one who may be placed over them. Disobedience is severely punished, and children are beaten most unmercifully by every one who fancies that they have some control over them. A little boy living near us, had his younger brother left in his charge. The boy, a mere child of eight or nine years of age, while playing with other children, forgot his charge a few moments, and it wandered into the street, where it was knocked down by a passing horse and wagon, but fortunately escaped without injury. Upon the return of the mother, she not only whipped the boy severely, but also suffered all of the child's relatives who learned of the affair to whip it. Several old women in the neighborhood who considered that they had some authority over the child, also came rod in hand, muttering imprecations as they walked against the carelessness of the boy, and whipped him. The accident occurred near night, and the child received his first series of whippings before dark and the punishment continued the next day until the middle of the forenoon, when distressd by the cries of the child, and indignant at the inhumanity of the excessive punishment for so small an offence, I interfered and prevented further castigation.

The prime factors in the religious belief of both negroes and creoles are the obeah men. Just how these leaders in obeahism originate I did not learn. I have, however been brought in contact with several creoles who claimed to have had the gift of being able to see spirits. This power, not possessed by every one was acquired by them at birth.

The presence of evil spirits, or spirits mischievously inclined are a source of great trouble to the natives of the Bahamas. Doors are not only always closed and barred at night, but window shutters, which are with the lower clases made solid without lattices, are also closed. Fortunately, the nights here are usually cool, yet this superstition must cause considerable inconvenience, if not positive illness, especially where several persons sleep in one room, as is frequently the case. I presume the enclosing of houses in high walls, as is almost always done, arose from the idea of keeping out evil spirits. This practice must also be detrimental in a sanitary point of view as it prevents the free circulation of air about the houses, for the walls are frequently very close to the house and are often nearly as high as the house itself. A barrier of any kind seems to be considered as a protection for a field against the inroads of mischievous spirits, both mortal and immortal; even a single stick laid across the path that forms an entrance to a field is considered as an impassable barrier. I have frequently seen these bars so low that a child could step over them, yet a negro never leaves his field without closing the entrance in some way.

As remarked, few of the creoles or negroes can read, consequently their traditions are orally given, hence it is that most all are practiced story tellers, depicting the scenes which they wish to portray with great vividness. The following are some of the stories told me regarding spirits. I wish I could record them in the exact language of their authors, but as I only made notes of the facts I cannot do so.

Two boys came to my house one day to watch me as I sat at work on some birds, and while there related the following story.

On the previous evening they had accompanied their father to the city, for they lived on the outskirts, a mile and a half from the center. Here the father left them at the house of a friend, promising to call for them, and take them home: this, however, he neglected to do, and so the boys after waiting until nearly nine o'clock were forced to return alone. Now they had to pass a rather lonely bit of road which run close by the water of the harbor, known as the white ground. This spot is haunted by a malignant spirit known as the Hog Island man All went well with the children, as they speed on their homeward way till they came to the white ground, when suddenly their progress was arrested by a man so huge that one foot rested on Hog Island, (a half mile away) and the other on the white ground. In his hand he carried a lantern, of such enormous dimensions that when he sat it down in the road it completely barred the way, and he seemed determined to prevent the children from reaching their home, by the use of this novel barrier, for whenever they approached him he would lower the lantern directly in their path. After trying several times to pass, the terrified children were compelled to turn and fly back to the city and seek shelter in the house of the friend whom they had just left.

This story was told in the presence of several creoles, all of whom sympathised with the children, no one expressing the slightest doubt as to the truth of the story.

As our vessel was coming to anchor near some houses that stood on the south shore of Middle Bight, Andros Island, I noticed two women running rapidly along the shore toward the houses and saw that they were met by a party of men and women who came hurriedly from the houses. These gathered about the two women so closely that I could not see what transpired, as I was some distance away. The cause of the excitement was afterwards explained to me as follows:—Two girls had started in the afternoon to walk down the shore to Niven's Hill, a small settlement about two miles distant, situated on the shore of the Tongue of Ocean: the way was lonely with no houses whatever. When half way to the place the two girls were met by three men, whom they knew at once to be spirits and who with joined hands tried to prevent the girls from proceeding on their way. After attempting several times to pass, both of the frightened females turned and fled. When they reached their sympathizing friends both fell to the ground in convulsions, and were carried to the houses in this condition, and it was some time before they recovered.

A man whom I employed as a pilot when I was on Andros Island was a professional ghost seer, and related many tales of spiritual encounters.

Once when this man was out hunting among the Crow Hills, in which were several caves, he shot a dove, (a zanaida dove) and as he went forward to pick it up he was anticipatd in the act by the spirit of an Indian woman who came out of a neighboring cave, moving with great deliberation, and without regarding the rightful owner of the bird calmly stooped, took it in her hand, then returned to the cave. This particular cave the pilot assured me contained many remains of Indian utensils.

The pilot of whom I have spoken had been twice married, living with his first wife on New Providence, but moved with the second wife to Andros; here he was much troubled by visits from the spirit of his dead first wife, she being jealous and inclined to do some injury to the person of her rival. The second woman, was however, unaware of these attempts, but the husband in capacity of ghost seer was perfectly cognizant of it all, and always prevented any mischief. One day, or rather evening, shortly before my visit, he was standing in the door-way of his house, which overlooked the Bight, when he saw the mischievous spirit of his departed first choice coming across the water, in the shape of some formless object. At once divining that the ghost was bent on vengeance, the husband turned quickly, closed the front door and hastened toward the back entrance, taking up his loaded gun as he passed it where it stood leaning against the wall. Now spirits are perfectly safe from any ordinary shot, which passes hramlessly through their bodyless forms, nor can they ever be killed again, as they are already dead, but with certain ammunition they can be grievously hurt. Here as elsewhere the traditional silver bullet has a potent effect, but silver in any form is too precious in the Bahamas to waste on ghosts, and our hero knew of a far more easily obtained projectile. As he passed out of the door he stooped down and scooped some earth into the muzzle of his gun. He then ran quickly around the house, turning the corner just in time to meet the evilly disposed spirit as it approached the door. Quickly raising his gun, the pilot fired. As the report went echoing along the level land the ghost, badly injured by the earthy shot gave a loud cry, and immediately assuming the form of a large black dog, ran ki–i–ing to the water over which it ran, or skimmed, and disappeared in the darkness.

The pilot told me another story in which there was an apparent cause for an hallucination. He was going from one point to another on Big-wood Key, which lies at the mouth of the Bight, armed this time with a bottle of rum from which, according to his own confession, he had been imbibing rather freely, when in a lonely place he was met by the spirit of an old man who without a moments pause, and in a most unjustifiable manner, tried to obtain possession of the rum bottle. Just how he made the attempt my informant could not clearly relate, but that he exercised considerable strength was certain, and it was only after a hard and long fight that the pilot came off victorious and arrived at his destination with some of the rum still in the bottle.

On the Bahamas, as in all lands which have been frequented by pirates, are traditions of buried treasures. Here also the treasures have their supernatural guardians, sometimes only one spirit and sometimes more watch the spot where the ill-gotten treasure is deposited. These guardians are called "keepers" and do not appear to be the spirits of departed mortals, nor do they seem evil spirits: at least they are sometimes favorably disposed toward certain mortals: mortals who are born under certain favorable circumstances. That is, the keepers are inclined to deliver up the treasure which they guard to any of these favored individuals, but never without first subjecting them to some peculiar test.

On one of my trips among the islands when southward bound from Nassau to Green Key, a little lonely island which lies on the edge of the bank near the southern extremity of that singular estuary known as the Tongue of Ocean, we were accompanied by one of these very individuals who had entered life in the peculiar manner which made him a favorite with the treasure keepers. He was a small man, with little flesh on his bones. Regarding his age, this was uncertain, for although his face was so seamed with wrinkles that it was impossible to put the tip of one's little finger on his countenance anywhere without covering several, it is extremely probable that he had borne these marks from a very early age, as is not unusual with some men, hence it was impossible to judge how long he had lived, he might have been fifty, sixty, or even more advanced. At all events he had passed time enough among his fellow men to have become a fine story teller. His manner of relating tales was simply charming, for in holding the attention spellbound he rivalled Defoe, and the unknown author of the Arabian Nights.

I have said that we were bound for Green Key, and as the scene of the story that I shall first tell is laid there, I will give a short sketch of the topography of this little island and of its history. Green Key lies about fifty miles south of New Providence, and as remarked, directly on the edge of the deep water of the Tongue of Ocean which lies between it and Andros Island, that is situated about twenty miles to the westward; southward there is no land between the key and Cuba, nor to the eastward, save a few small islets, mere points of rocks, or sand bars, until we reach the outer line of Bahama Islands many miles away. Thus Green Key is quite a lonely island. It is circular in form, and about a mile and a half in diameter, rather low on the outer margin but rises toward the center, where is a flat table land about fifteen feet above sea level.

On this table land once stood a house, now fallen into ruins, for the island was once inhabited by a Scotchman, who lived there a number of years, and raised sheep. Evidently this man had made some clearings about his house, but these had become overgrown with vegetation, and consequently the whole island, excepting a spot here and there, was a mass of thick shrubbery, through which it was difficult to make one's way. This woodland was made up of low trees of an average height of about twelve feet. These trees were of the ordinary species found in the Bahamas, but scattered among them, often growing in clumps were many palm trees, known among the inhabitants as the "top tree." From the leaves of this tree is procured the material from which hats, baskets, and a coarse rope is made. The spongers in passing the key when going to or coming from their fishing grounds, frequently stop there to gather tops, and it was during a visit to Green Key, with a party of comrades, that my sailor met with the adventure related below.

He had landed on Green Key with a half dozen other creoles, and all scattered about the island in search of top trees. Our hero after walking about some time without being very successful, and without observing closely in which direction he was going, found himself in the vicinity of the ruin of the house. Then there was a little clearing about it, and he walked into this idly, without any special purpose, when suddenly he felt impelled by some power, what, he could not tell, to go into the scrub in an easterly direction. So strong was this inclination to move in this direction that without hesitation he obeyed it, and at once walked to the edge of the clearing, when he perceived an open pathway where he was certain he had never seen anything of the kind before.

Not stopping, however, to consider anything about the matter, he at once entered the track. This led him in a perfectly straight line for some distance, how far he could not say, when it opened into a little clearing, only a few yards in diameter. In the center of this spot stood a tall man with a long gray beard, who after looking attentively at the creole a moment, raised his hand and pointing toward his feet suddenly vanished. Still under the influence of this strange power the sailor, although greatly astonished, was not frightened at this strange apparition, so he boldly advanced to the spot where the old man had stood. Here he was more surprised to find what he called a tomb, that is, a flat stone five or six feet long supported by brickwork. Then it at once occurred to our creole that this was a place where treasure was buried, and that the old man was no less than a "keeper" who was favorably inclined toward him. In short, before him lay a fortune, and he had only to secure it.

Leaning over to examine the top of the stone more attentively, the sailor saw that it was covered with printing cut in the surface. Like very many of his fellows, this man had never learned to read, thus was unable to decipher one word of the inscription. This he considered particularly unfortunate, as he thought herein were contained instructions for gaining the treasure.

After considering awhile our hero concluded to make the attempt. So he took hold of one end of the stone and succeeded in raising it quite readily, but when he attempted to draw it to one side, some hidden force pulled it so strongly downward that he was obliged to let it fall into its place again. He immediately went to the other end and tried to move that, but without success; the same power interfering, and the stone fell into its place once more. Without being discouraged however, he tried again and again, but all his efforts proved futile; the stone was always forced back upon the brick-work.

The creole then changed his method of attack upon the mysterious tomb, and began to remove the bricks; this he easily accomplished as far as the surface of the ground, but the stone fell down as he removed each successive layer. Some time was occupied by these labors, and night was approaching. Not wishing to remain in the place after dark, the man concluded he would go back and find his companions, and get them to assist him. Now it appears to have occurred to him that it might be difficult to find the place again, so he gathered an armful of bricks, and turned back along the path, dropping a brick at intervals, and breaking the bushes; in this way marking the path to the opening near the house.

After a short time he found two or three of his friends, and returned to the clearing, and going to the exact spot near the house from which he started when he first entered the path which led to the treasure, he proceeded to the point where the way had opened, but much to his surprise not a sign of a path could he see, nor was there a trace of a broken bush or of a brick to be found. Furthermore, a long and careful search made by the entire party of all the shrubbery in the vicinity of the discovery failed to reveal anything which gave the slightest clue to the presence of the objects for which they were looking; all, pathway, broken bushes, bricks, and tomb were gone! No one has ever been able to obtain a trace of any of them since, and upon my visit to Green Key the sailor pointed out to me the spot where he supposed the treasure was hidden, a small natural opening in the scrub.

When I asked the creole why he thought he did not succeed in getting the treasuse, he said that he did not undergo the test to which the "keeper" intended to subject him. He should have remained there till night, when he could have removed the stone. To illustrate that it was the habit of treasure keepers to subject the individuals whom they were inclined to favor, to a test of some kind, he related the following story.

South of Middle Bight, Andros, is a range of hills known as the Crow Hills. These extend from the middle portion of the island eastward quite to the coast, terminating in cliffs, the top of which overlook the open water. Now all through the Bahamas are what are known as pot holes; pits in the solid rock, evidently made by the action of the water when the islands were submerged. These holes vary in size from a few inches in depth and diameter to well-like excavations many feet in depth and often ten or fifteen feet in diameter. Andros is particularly favored with these pit holes, in fact, they are so abundant that no hoofed animal larger than a goat can exist. The coast cliffs of the Crow Hills form no exception to the rule, and there are several of these large pits within a few square yards, in one particular spot, directly in view of the sea.

A ghost seer, becoming impressed with the idea that a treasure was hidden in one of these pits, determined one moonlight night to watch near them for some sign as to which particular pit held the treasure. Accordingly night-fall found him seated on the cliff. The stillness was profound, broken only by the chirping of insects in the scrub, or by the cries of the tree-frogs in the air plants. The sea was perfectly calm, for there was not a breath of wind, and the watcher sat looking out over the water, which was brilliantly illumined by the full moon, till late at night, how late he could not say, when far out on the Tongue of Ocean he saw a large vessel with all sails set. The presence of a ship, for he could see that she was a full rigged ship, in this place was surprising, as the southern portion of the Tongue is surrounded by shoals with narrow passages only between, and large square rigged vessels never attempt to pass through them ; hence a vessel of this description was most evidently out of place there.

Gazing at her attentively, the man soon perceived something singular; in the first place, although in unknown waters at night, near land, the sails of the ship were all set. But what seemed most strange was the fact that she appeared to be coming in toward the land quite rapidly, and, be it remembered, there was not a breath of air stirring. All along the eastern coast of Andros extends a barrier reef of coral, with passages for small crafts only; of this, however, the stranger did did not appear aware, for she sailed head on for the land As the ship neared the point where the reef lay concealed, the treasure seeker fully expected to see her put about, but to his great surprise she not only kept sailing smoothly on in a direct line for the land, but passed the reef in perfect safety. Then she was in comparatively shallow water, filled with shoals and coral heads, yet on she sailed, passing all these dangers as safely as if they never existed. The lagoon at this point, between the reef and the land, is wide, but the ship came across it in a very short time, and was soon within a mile of the shore where the water was too shallow to float her ; yet on she came with undiminished speed, but showing more and more of her hull as she advanced, until at last she quite left the water and was sailing through the air ! The vessel's course continued slightly upward, and as she neared the cliffs it became very evident that she would pass some distance above them. When within a few hundred yards of the spot where the astonished watcher stood. near enough for him to see her decks filled with sailors. they began to take in sail. Now the decks were on a level with his eye and the voices of the officers could be plainly heard, ordering in sail after sail. until all were snug against the yards, and the speed of the vessel was greatly slackened. but she still retained sufficient headway to carry her almost over the head of the creole. As the ship approached in this unheard of manner he had concluded that she was in some way to point out the position of the treasure. so he courageously maintained his post. although the bow-sprit of the huge ship projected directly over him. Suddenly, however, he heard the order given to cast anchor, and looking upward saw an enormous anchor appearently about to be dropped upon his head. Then he could stand it no longer; giving a loud scream he turned and fled down the hill. and so lost forever his opportunity of securing the treasure.

Fig. 1.

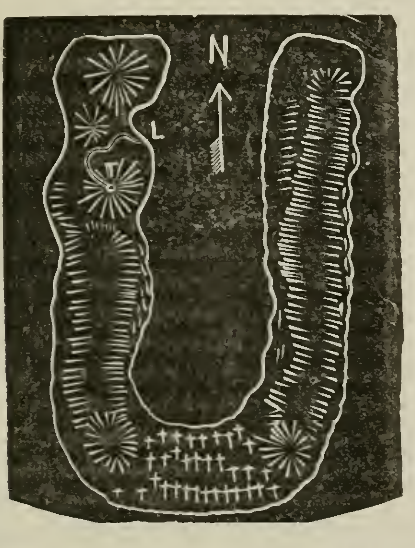


Diagram of U Key, Bahamas. L, landing: T, treasure pit.

In April, 1893. in company with Mr. G. F. Curtiss and Dr. Thorndike, I visited a little key, forming one of the Allen's Harbor group. This island is one of the most peculiar in form of any that I have seen among the Bahamas. It is a portion of an elevated, oval atoll, of which the northern end has been washed away, or, what is more probable, was never formed. As it has no name given on the charts, suggested by its present appearance, (see fig. 1) I have called it U Key.

This remarkably formed island is well known among all the creoles as a place where treasure is supposed to be buried. While we were on our way over to the key the captain of our vessel mentioned the matter, and said that he with two others had recently spent a day and a night in searching for the treasure in a pit hole.

Before we landed on U Key, while on Highborn Key, a large fertile island a short distance south, but, like all the keys for many miles around, entirely destitute of human inhabitants, the captain, while alone with me related the tradition concerning the treasure. He believed most implicitly in the story which he told, but was evidently shy of telling it when with all of us. I have always found that in order to induce the Bahamans to speak freely of their superstitions, one must be thoroughly in sympathy with them. The slightest appearance of skepticism will cause them to become exceedingly reticent upon such subjects. The Captain and I had been off collecting together, and had seated ourselves to rest in a ravine. The place was picturesquely wild. On three sides rose gray, rocky cliffs, in which several caves opened their dark mouths. Over them and along the crests of the cliffs towered palm trees, which bent forward so as to very nearly obscure the sky. The valley sloped from our feet to the sea, and although we could hear the waves dashing against the rocks below, we could not see the water.

It is highly probable that these somewhat weird surroundings had their influence upon my companion, for we had been among them but a few moments when he began to speak of the treasure island, and finally told the following tale.

Tradition had long pointed to one of the small keys about Allen's Harbor as the hiding place of buccaneer's money, but no one could tell upon which of the islands to search, until some forty years ago, when the matter was made plain to a man who lived at the Current. This man, in company with three or four comrades, was cruising in a small vessel, and had put into the little harbor of U Key for shelter. All of the men had gone away fishing to a distant bank, excepting the hero of the tale, who, after a time concluded to go ashore on U Key. Taking a boat he skulled to the shore, making a landing at a point between two hills, (see fig 1, L) where there is a nearly level spot of land. For some reason the creole did not leave the boat immediately, but stayed in her with her bow resting on the little beach. He had been there but a moment when he was surprised to see a man, clad in old time sailor garments, emerge from the bushes near, and approach him.

The stranger came up to the boat, greeted our hero, and asked him what he did there. The creole replied, that he was trying to get an honest living. "Come with me and I will show you how to get an easy living", said the sailor. The creole at once left the boat, and was led by his guide along a path that led up the side of the rocky elevation to the left. Reaching the top, they passed about half way down the other side, when the sailor paused and, pointing to a pit hole, said, "wait here a moment" He then disappeared in the bushes. In an instant the sailor returned, but to the amazement and horror of our treasure seeker, he came back without his head. Not waiting a second for farther developments, the creole fled, nor paused in his headlong flight until he found himself in the cabin of his vessel, where he passed the time, until the return of his companions in great terror.

After hearing the story which their comrade related to them upon their return, the men concluded that one of them had better remain on deck to watch that night. One volunteered to do this, and was left alone. Nothing unusual occurred until about midnight, when the watch heard dogs barking on the key, then the voices of men; finally came a hail, thus; "Boat ahoy! Come ashore!" This was repeated at intervals for some time, then all was silent.

So real had seemed these voices of the night to the watchman that the next morning he went ashore, and searched over the entire island. Now as the key is only about a quarter of a mile long, and nowhere over a hundred yards from shore to shore, this was soon accomplished· But not a trace of a dog nor of a human being was to be found.

Terrified beyond expression at these adventures, the men left the neighborhood of Allen's Harbor and did not return to the place for some years, agreeing among themselves to keep the whole affair a profound secret. But the matter leaked out, and many have since searched for a fortune on U Key.

FIG. 2

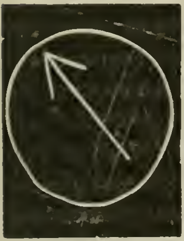


Figure on rock, U Key.

The next morning I stood with the captain by the side of the famous pit hole. It differed in no remarkable way from hundreds of similar holes that I had seen. It was about twelve feet deep by five in diameter. On a flat place on the rock, near the mouth, was cut a rude circle, about two inches in diameter, (see fig 2) within which was an arrow pointing toward the hole. This device had evidently been placed there many years before, but had been imitated in a variety of places by visitors, who had frequently added the initials of their names and date of landing. The oldest record that I could find was 1863. There were about fifty of these evidences of worshipers at this shrine of fortune, and as but comparatively few creoles can write, this must have represented a very small proportion of the numbers who flocked to this Bahaman Mecca.

We will now return to those men, who have a power, given at birth, and always retained, for it is possible that from these gifted individuals spring the obeah men.

One of the principal and most apparent occupations of the obeah men, is the manufactory of "gummas" and the "working of gummas." A gumma is a kind of fetich, a charm of some kind to be placed in a field as a protection of the products of that field against theft. All of the fruit and vegetables growing in that field are poisoned by this gumma. Any one eating these products, who is not the legitimate owner, will swell up and expire in great pain. The gummas themselves are of various forms and material. The most usual in Nassau and vicinity were bottles containing a little water and some earth, supposed to have been taken from a grave. These were suspended by a cord tied around the neck, to a pole. Sometimes a conch shell containing water and earth is used. More rarely a small bundle tied up in a rag is seen, but this is the prevalent gumma exposed in the fields on Inagua. Most rare of all are carved images. I found one of which I give a drawing, on plate I. that was perched on the limb of a small pine tree near the entrance of a field that was cultivated by some Congos. This fetich is about eight inches high, and is made of a kind of soft wood known as stopper wood. As seen, it is a rude figure of a man, and around the head is twisted some red and white woolen yarn. Another fetich that I found also near a field cultivated by an African, was comparatively elaborate in structure. It consisted of the tip of a cow's horn with a pole thrust into the cavity at the base; on its tip was fastened a flat cork, and through the edge of this cork were thrust several pins, points upward, while beneath the horn was hung a bottle containing earth and water. The height of the pole was about six feet. Fig. 3, A.

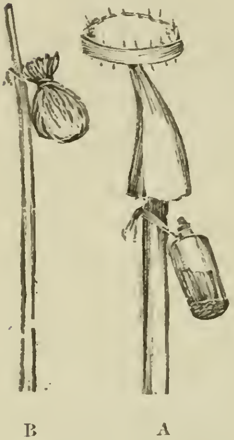
All of the negroes and creoles with whom I conversed, place the most implicite faith in the baneful influence of these gummas. No one would think of taking fruit or vegetables from a field so guarded, without the consent of the owner. There are however. exceptions to this rule. Among the crew of one of the vessels that I chartered while among the Bahamas, was one of the favored individuals who from his birth was privileged to see spirits; he was also exempt from the noxious influence of gummas. In walking through the fields of Andros he would frequently gather peanuts and paw-paws and eat them, whereas none of the other men could be induced to touch them, although I endeavored to induce them to do so. Many instances were related to me where people had been poisoned by gumma-guarded fruit and vegetables. I could not learn that anyone had actually died from this cause, for as soon as the pain became unbearable, the afflicted one would go to the owner of the field and make confession of his crime, when either by payment for the stolen property or in some other way, he would induce the man whom he had wronged to go to the "gumma man" (obeah-man) and have the noxious quality removed from the swallowed fruit, when the patient would recover forthwith.

Aside from the manufacture of these fetishes comes the more objectionable portion of the craft of the obeah-man, and that is working gummas, or working charms, in various mysterious ways to cause the sickness of individuals at the solicitation of others. Herein lies the power of the obeah doctors over the people. He can work the most potent charm and apply it without the knowledge of the victim, who is as a consequence visited by some ill, curable by the gumma-man only.

How much or little the obeah-man believes in the potency of his own charms is difficult to state, but that he sometimes imposes upon his subjects may be seen from the following. I was informed that a gumma worker made two large sized manikins, or as my informant expressed it, two dolls, dressed grotesquely. These were placed by the side of a pathway that ran through a dense thicket. It is quite usual to find these narrow pathways about Nassau, for many colored people in conveying their goods to market carry them in trays placed on the head. The gumma-man was concealed in the thicket, and whenever anyone approached his figures he spoke to them in a tone of voice that was intended to convey the idea that it came from one of the gummas, forbidding them to pass without the payment of money. The credulous, frightened negroes always obeyed this summons. The affair coming to the knowledge of the officers of the local government, a raid was made by a policeman and the gummas captured, but the gumma worker escaped.

In Jamaica, where the obeah doctors have given the British Government considerable trouble, the power of these charm workers is very great. Here they are said to "set a coffin to catch a man's shadow", in other words, the obeah-man will catch a person's spirit, shut it up in some limbo, and thus prevent it from entering into a future state of bliss. The limbo may be a corked bottle, or even any enclosure guarded by supernatural means, induced by the incantations of the obeah doctor.

Fig. 3.



Field fetiches; A, from Nassau; B, from Inagua.

The separation of the spirit from the body does not necessarily mean the death of the person whose shadow is thus imprisoned, or, at least, not his instantaneous death. A person may have lost his spirit and yet be alive, nor is the individual always conscious of this loss.

All dogs have the faculty of recognizing spirits invisible to mortal ken, and indicate the presence of these supernatural intruders by barking. The following story will not only give the idea that dogs can see spirits, even under peculiar circumstances, but also the opinion regarding living spiritless bodies.

There once lived in Nassau a negro who was a native of Hayti, and who was called Mouser. This man lived with his family in a small house, which stood in the yard of a larger residence. There was a dog kept in this yard, which when I came to live in the neighborhood, I was inclined to regard as unmitigated nuisance, for it had the habit of frequently barking at night, without, what appeared to me, sufficient provocation. When I complained to its mistress of this, however, I was told that the animal was regarded as the most intelligent dog in Nassau, as it could recognize wandering spirits quicker than others; hence its barking habit. Its mistress, as proof of its sagacity, told me this story. Mouser, the Haytian, was accustomed to go out every day to work, returning at night. One day he returned quite early, and as he came into the yard, Lady the dog at once ran to him, and instead of the friendly greeting which she usually gave him, she barked at him loudly and continued barking, running by his side until he had entered his house. The negro complained of an illness which increased to an alarming extent, and before morning he was dead. Then came the explanation of Lady's singular conduct: she, with wonderful sagacity had perceived that Mouser's spirit had left his body and was walking by his side, and it was this bodyless ghost at which she barked.

There was one belief among the creoles that interested me greatly, because at first I thought it might have some foundation in fact. This was a belief in a monstruos animal called the yahoo. Singularly this creature was ape-like with human intellect, and differed otherwise from the well known yahoo of Swift, described in his land of the Houyhnhums, in being of a gigantic size, and in being endowed with a supernatural character.

While at Nassau, I frequently heard of this yahoo and was always told that he lived on Andros, alone, inhabiting the wild section which lies south of the Southern Bight. Most of the stories told of this yahoo were wild to an extreme degree, and highly improbable, but one related to me by a very intelligent man who had a plantation on Andros, led me to think, as previously remarked, that there might be some foundation to all of these tales.

The narrative is as follows. It has long been a custom of the creoles to visit the rocky elevations which lie south of Southern Bight, in order to hunt the iguana, a large lizard, the flesh of which is eaten. Dogs are employed to hunt these animals, as they force the lizards to to climb trees, where they are at the mercy of the hunter, by preventing them from entering their holes in the rocks.

An iguana hunter, accompanied by three dogs, came to the northern side of the Crow Hills one morning, and remaining on the level ground, sent his dogs on in advance. They climbed the rocks, and evidently scenting some game, dashed rapidly onward. All three reached the top of the acclivity together, and together disappeared over it. A moment after they were heard barking excitedly, but soon these sounds changed to yelps of fear and pain. Then immediately one appeared, retreating in great alarm, followed more slowly by a second. The first dog ran toward his master, exhibiting every sign of extreme terror, and when he came near enough the man saw that the animal was badly wounded by some sharp instrument. The second dog was even more badly cut in long gashes upon his body, so badly, in fact, that he expiered at his master's feet. The third dog never came back. Attributing this mutilation of his dog to the yahoo, the creole at once left the place, and to this day creoles are shy of the neighborhood about the Crow Hills.

Discarding, of course, all of the supernatural portion of the story, I endeavored to account for the mutilation of the dogs, which appears upon good evidence to have been a fact, by supposing that it might have been done by an Indian; possibly one of the remnants of the lost tribe of Indians which formally inhabited all of the Bahamas. This hypothesis was strengthened by the story of the supposed spirit of the Indian woman, related on page 7. When we consider that Andros Island is ninty miles long by thirty wide, and that it is sparcely settled, the inhabitants living along the extreme eastern coast, mostly north of Southern Bight. then add to this the fact that, with one exception, the island has never been crossed on land by any one, and it can be conceived that this wide, wooded interior might offer a home for a considerable number of people. Such people, if they had a reason for concealing themselves, could have existed there many years without having been discovered.

I have conversed with several creoles who stated in the most positive terms that, when passing in their boats, they have seen the yahoo seated on the rocks fishing, and that he always retreated when approached. All of these stories seemed to point to the existence of some one who lived in the region that I have indicated, and who wished to remain unknown to the creols. I do not think any negro would live in that remote section, but a white man might. While confessing that my theory concerning the lost Indians is badly shaken, I may say that I still think that a thorough examination of that portion of Andros which lies south of the Crow Hills will reveal enough to pay for the labor expended.

But to return to the yahoo and to the traditions concerning him. The pilot of whom I have spoken as a ghost seer, and who encountered the spirit of the Indian woman, professed to know all about the yahoo, and much which I now relate concerning the monster I learned from this man. His stories were, however, always strongly indorsed by the other men. and appeared to be prevelant legends.

Formally the yahoo lived on Cat Island. Here a woman, wife of of captain of a vessel first came in contact with him. The captain had landed on a wild portion of the island for a supply of water, and while the casks were being filled, allowed his wife, who accompanied him, to go ashore. She wandered away into the shrubbery, disappearing from sight, but when all were ready to go aboard she could not be found. A long, careful search, prolonged for two or three days, failed to reveal even a trace of her, and reluctantly the captain sailed away without her.

One year from the date of the disappearance of his wife, found our captain with his vessel once more at the same place on Cat Island, to procure water again. As the Captain, accompanied by his men, went toward the well, to his great surprise he saw his long lost wife coming toward him. Hastily greeting him, she told him that she had been carried off by a huge, hairy man, and that the monster was then not far away. She then entreated him to take her aboard his ship. Alarmed at this story, all hastened into the boat and put off toward the vessel. Although they used all speed, they had not got many yards from land when the monster appeared. Enraged at the loss of the woman, he rushed yelling into the sea after the retreating boat. The strenuous efforts of the terrified men carried her beyond his reach, however ; then seeing all chance of recovering the woman was lost, the huge animal turned and rushed back into the woods .In a moment he reappeared, brandishing a young child by one leg. Running quickly to the edge of the water, the monster tore the child in two, threw one half after the boat, and kept the other.

This story was heard by the men of my crew without comment, as it was evidently not new to them, but the cabin boy who was apparently unfamiliar with it, and who seemed impressed with the somewhat tragical conclusion, remarked, that " half a child was of no service to any one".

This was the original appearance of the yahoo. Later, upon the settlement of Cat Island, he moved to Andros. He is endowed with supernatural powers, can jump the Bights at a bound, passes through the thickest scrub with the greatest ease, and cannot be killed with ordinary ammunition, for a silver bullet must be used. When I expressed a desire, before several creoles, to be placed face to face with the yahoo, rifle in hand, and try the efficacy of a leaden bullet, and offered twenty-five dollars to the man who would bring about this meeting, there arose a storm of protestations. I should be killed outright by the monster if I tried such a foolhardy adventure, but one old man said he thought that I would be perfectly safe, if, after firing, I jumped into the smoke.

In the stories of the yahoo we can possibly trace remnants of an African tradition of the far off gorilla, but whether this is so, or whether he is wholly a ceature of the vivid imagination of the creole, he certainly seems very real to the Andros Islanders.

Although, as already indicated, the creoles are aware that the Bahamas were formally inhabited by Indians, they do not appear to recognize any of the stone impliments, when they find them, as having formally been used by the red men. All stone axes, chisels, etc. are called thunderbolts and are supposed to have their origin in flashes of lightning when they strike the earth.

While Mr. Curtiss and myself were on Andros the past spring several of these axes were brought to us by the creoles. These impliments are made with great care out of a hard green stone, beautifully polished. (See plate II.) This was proclaimed by its former owner to be a thunderbolt, and he decaired that he saw the lightning which produced it. When we tried to purchase those thunderbolts we found no difficulty in so doing if the owner had more than one, but if he had one only he could not be induced to part with it for any sum. The reason that the creoles gave for this was, that they wanted the stones to protect their houses from lightning, for a house in which one was kept was perfectly safe. When first found these thunderbolts are said to burn a thread in two if it is wrapped around any of them.

In the foregoing pages I have endeavored to indicate some of the the leading superstitions of the creoles, but many minor subjects and peculiarities I have not touched upon, for the vivid imagination of these people is always presenting pictures most singular. They are all apt to personify objects of all kinds. A woman taking shelter in my house, one day, to avoid a sharp shower, said, "The rain says, hear me, I come", and one hears many similar remarks.

Turning from this race with all its richness of imagery, and power of depicting scenes, which they wish to impress upon the mind, to a colder, less imaginative race: the whites of the Cayman Islands.

These people are simple, industrious, and intensely religous, but upon a vastly higher plain than is the African or his descendants. Superstitions we find among the lower classes of these stern descendants of buccaneers, but they are similar superstitions to those which were prevalent in New England two hundred years ago: the Caymansmen do not people their woodlands with monsters, nor with dark, malignant spirits of ultra-supernatural origin; all of their ghosts are honest, legitimate ghosts.

While I was on the Caymans I had, for a time, two brothers for boatmen, both of whom were well into middle life. They had always lived on the islands, in fact, I believe that neither of them had ever been out of sight of the little island of Cayman Brac, where they were born. These men may well be taken as typical representatives of the common people. Their simplicity may be illustrated by the following incident. Speaking of the stars, one day, one of them asked me what I thought they were. When I, evading the question, asked him for his opinion, said: "Our new minister [sent by the Baptist Missionary Society of Jamaica] told us that they are great globes of fire like the sun but we think differently. We think that they are holes in the sky through which we can see the light of heaven." He then went on to explain how the port-holes of a ship can be seen a long distance quite easily, when lighted from within; the holes in the sky were similar and could be seen, although they are very far from us.

One story, out of several, will serve to illustrate my boatmen's idea of spirits. On the north side of Little Cayman is a reef enclosed harbor known as Bloody Bay. Here, many years ago, a crew of pirates were surprised, when ashore, by a British man of war, and slaughtered to a man. Now, during severe storms, at night, the pirates can be heard fighting that fatal battle over again, and the next morning blood stains may be found upon the sands. Neither of the brothers had ever seen the blood, but others had, and they believed that it was found there.

TRACES OF THE LUCAYAN INDIANS IN THE BAHAMAS.

The red race of men that inhabited the Bahamas at the time of the discovery of the islands by Columbus, seem to have disappeared early in the sixteenth century. Indeed, it is probable that within twenty-five years after the invasion of the Spainards that few, if any, of the race remained, whose whereabouts were known to the whites. They are said to have been wholly exterminated by their conquerors, who captured them all, in order to compel them to labor in the gold mines of the Island of Cuba, or to fish for pearls along its shores. Just how a native people, familliar with the land and with all its fastnesses, could have all been captured by white men, comparative strangers to the country, who must have found it exceedingly difficult, if not absolutely impossible to penetrate far into the interior of the larger islands, is hard to conjecture.

At all events, the Lucayan Indians did disappear from all knowledge of the whites, and today we have to regret the loss of the entire race, with its history unwritten. Hence it is that anything appertaining to the history of this lost people is of great interest and importance.

In the following pages I shall endeavor to show what I believe to be some traces of how these Indians lived, and, to some extent, upon what they subsisted. When we consider, however, that nearly four hundred years have passed away since the Lucayans lived on the Bahamas. and that since then many generations of a race, mainly ignorant and superstious, who would be likely usually to destroy rather than preserve, any traces of the red race, any remaining evidence of the exitence of the Indians must be very slight.

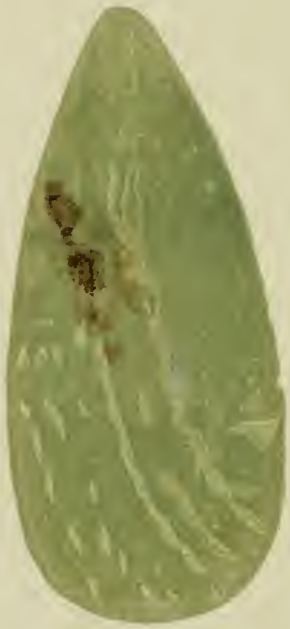
It is owing only to the facts that the Bahamas lie entirely beyond the disintegrating influence of frost, and that the rain-fall is very slight that we find most of the traces which do exist.

When Mr. Curtiss and myself were searching for land shells on one of the little keys which lies north of Allen's harbor, we discovered what was most evidently an old well, and as it was situated in the thick scrub, we concluded that it was dug by Indians. This conclusion was born out by its peculiar form, and by finding a heap of conch shells near it which exibited every mark of having lain undisturbed for a long period of time. These shells had also been opened in a different manner from that practised by the creoles: but of these shells I shall speak later.

The surface of the Bahama Islands is nearly everywhere formed of the rock known as aeolian limestone. That is, the rock is formed of very small, rounded, quite regularly sized, particles of limy sand, which once formed a part of shells, coral etc., broken and ground into fragments by the waves, thrown ashore by them, then blown further inland by the winds, and finally the particles have become cemented together through the action of water on the sand.

Either from upheavals, shrinkage, or from some other cause, this rock has become cracked in very many places. From these cracks grow, mainly, all of the trees and shrubs which are found on the islands, very thickly in places, but rarely luxuriantly. The reason why the the trees grow in this manner is, that there is little or no soil anywhere on the islands. To be sure, there is a little accumulation in holes from the decaying of vegetable matter, but this deposit is very slight. so that nearly all of the rocks of the interior are exposed. Of course along the sea, where the shore is low, sand accumulates, and this is often blown by the wind some distance inland. In other places there are marl flats or muddy salinas; but these matters do not come within the scope of the present article. I wished only to speak of the general rocky surface, as a preliminary to describing the Indian wells.

PLATE II.

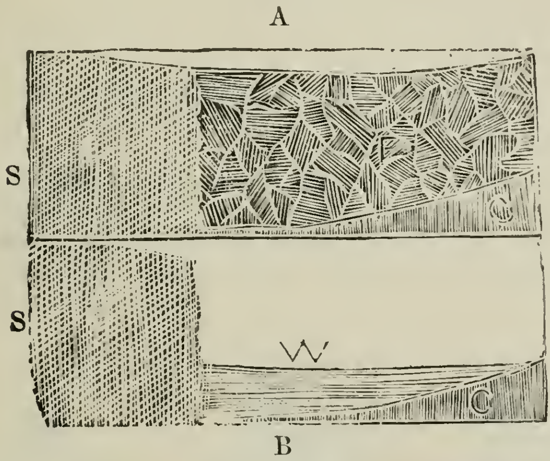


Indian stone axe. Middle Bight. Andros. Bahamas

I have spoken of the cracks or crevices in the rocks. Sometimes these extend downward for two or three feet, then the blocks of limestone, thus marked out, will often scale off from the foundation rock. It frequently happens that blocks thus isolated break up into comparatively small fragments and that these fragments will lie along a nearly solid wall. When the neighboring surface of the rock slopes toward a mass of fragments, situated in this way, water will flow among them and accumulates there.

Whoever made the wells of which I speak, took advantage of the circumstances, and by removing the loose fragments found the water. This is easily seen by referring to Fig. 4, where I have given a section of such a well; A, before the fragments were removed; B, after; S, is the solid rock; C, the slope; F, the fragments; W, the water in the finished excavation. The whole forms a well such as a primative people, who had no tools with which to excavate solid rock, could dig under existing circumstances. That the supply of water from these wells would, in most cases prove unfailing, is beyound doubt. In fact, I know of two wells, which I am sure were originally dug by Indians, which are constantly used by the creoles, as they are never dry. One of these is on Highborn Key and the other on Andros; but I shall speak of these wells later.

FIG. 4.



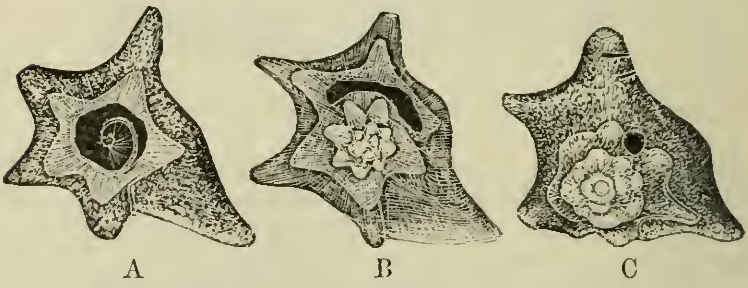
Section of Indian well; S, solid wall; F, fragments of rock; W, water; C, slope of rock.

The well on the Key at Allen's Harbor had been partly filled with an earth, resulting from the slow accumulation of vegetable matter, but it was then about three feet deep. The wall was on the eastern side, and the slope on the western. The entire excavation was about five feet from north to south, and some ten feet from east to west.

This well is, as already remarked, situated in a thick scrub, which completely covers the key, excepting along the immediate sea border. On the west side of the key, which is rather circular in form, and about a quarter of a mile in diameter, is a rocky shore, which changes abruptly into a sand beach after passing a point on the north-west. This beach extends around to the east, where rocks reappear and continue until they meet those on the west, but are broken directly south by a rather high sand spit, that extends out into a point. West of this point is a very small bay and directly north of it, about fifty yards in the scrub is the well. The key itself is the easternmost of the two which lie north of Allen's Harbor, and is due north of U Key, described in the preceding article, about half a mile distant. I have been particular in giving the exact locality of this and other wells, in order that they can be readily found by others.

Between the well at Allen's Harbor and the beach is the pile of conchs to which allusion has been made. They were all, as far as I examined them, of one species, the pink conch, Strombus gigas, and were all of the small, thick-lipped form of this species. Many of these shells were crumbling away, others, especially those on the top of the pile, were in an excellent state of preservation. Besides the very evident marks of great age, which all of these shells bore, they had all been opened in a peculiar manner. The animal of this species of mollusk is

FIG. 5.



Methods of opening conch shells; A, Indian; B, creole: C, buccaneer.

now largely used as food by all classes on the Bahamas, but more especially by the creoles. Now, the animal is large and its muscular attachment to the shell is very strong, and must be cut in order to remove the conch. This is readily accomplished by the creoles by breaking an elongated hole in the fifth whorl from the spire. See fig. 5, B, where I have given the spiral end of this and other conch shells, much reduced in size. A knife is thrust into this hole and the muscle cut, when the animal either falls out or is drawn out. This method of opening conchs is usual all over the Bahamas, and I have never seen them opened in any other way.

The shells found near the well all had a single, nearly circular hole in the fifth whorl from the apex. This hole was never over an inch in diameter, and, in all the shells examined, was made with almost mathematical exactness in the same relative position (see fig. 5, C). When I showed these shells to our men they were astonished, having never seen anything of the kind before. They could not conjecture how the holes were made, nor how the animal was removed. I afterwards showed similar shells to other creoles, and they all, with one exception, were completely puzzeled by them. The exception was a man who came to our camp ,while we were on Little Galden Key, in Middle Bight, Andros, and who said that they were opened by "old time folks", meaning the the inhabitants of the Bahamas in the days of slavery. He could give no reason for this opinion, however, and might have replied in the way he did because he thought I wanted an answer and desired to please me. One must use extreme caution when questioning the creoles, if he wishes to get at the exact knowledge which they possess of any subject, for if they have an idea of which way a white man wants his questions answered they are apt to try to give a satisfactory reply. Upon closely examining the cut of the Indian shell, fig. 5, C, it will be seen that the hole is not quite circular, and as this form suggested a clew toward identifying the implement which was used in making the holes in the shells, I shall return to the subject again later.

Highborn Key lies south of the Allen's Harbor group. It would be about circular in form were it not for the fact that it is indented from both the northern and southern sides by deep bays, which are nearly a quarter of a mile wide, and penetrate the key for one third of its diameter, thus the key forms a rude H. The land which lies between the inner terminations of the two bays, forming the cross bars of the H, is a low and sandy flat, while the elongated portions of the key, on either side, are composed of rocky elevations,but highest on the east. Thus it can be seen that Highborn Key is an elevated atoll, which formally had a channel at either end of the lagoon.

Approaching the key from the south, a landing place is found about half way up the bay, on the eastern side. This is used by the creoles as a drying place for sponges. Leaving the spongers camp ground, a path leads along the bay to its head, then enters the scrub, terminating, after passing through the thicket for about two hundred yards, at the Indian well, of which I have spoken as one which is now used by the spongers.

This well is similar in size and depth to the one already described, but the wall is on the northern side, with the slope on the south. The well is kept cleaned out by the spongers, and produces a small, though constant, supply of good, clear water, much superior to that obtained from modern wells much deeper, which are excavated in the solid rock, excepting that from the celebrated well at Fort Charlotte, New Provinence, which is ninty feet deep. The water in this Indian well was not affected by the rise and fall of the tide as it is in the more deeply excavated wells. When I visited Highborn Key this well probably contained all the water that there was for many miles around, and it was constantly visited by birds of several species, especially by doves, that were constantly there, but more abuntantly mornings and evenings. Our men, who filled our water casks at this well, had no idea that it had been constructed by Indians, but said that the well had always been there, and that no one knew by whom it was dug.

On New Providence, south of Wulfs Road, a street which runs back of Nassau, near the pine fields, is a depression which may have been an Indian well. This is, however, nearly filled with soil, which has spread over the neighboring rocks, and which bears a luxuriant growth of palms. These trees have, beyond doubt, greatly aided in the accumulation of soil.

South of Fresh Creek, Andros, about a quarter of a mile from the creek, by the side of a pathway that leads into some fields cultivated by the creoles, is a large Indian well, that, although partly filled with earth, contains water during the wet season. I do not think that it is now used by the creoles, nor could I learn that it ever had been. This well is easily found, as it lies directly by the side of the pathway which runs due south, beginning opposite the little church in the settlement of Fresh Creek. The well is about ten feet long and four feet deep.

On the north side of Middle Bight, Andros, on Bigwood Key, is a ittle creek. Just east of the mouth of this creek is another Indian well that is constantly used by the spongers, and the supply of water is never ending. This well is peculiarly situated, being directly on the bight, not ten yards from salt water, but the well is so much elevated that its water is not affected by the tide, and is as good as that from the well on Highborn Key.

Little Galden Key lies just within the entrance of Middle Bight, but on the south side, and about two miles from the creek of which I have spoken above, but, of course, on the opposite side of the bight. This is a small key, circular in form, not over a quarter of a mile in diameter. On the eastern side, where it is exposed to the waves of the Tongue of Ocean, it is high and rocky, but this sea wall slopes rapidly on the inner side, leaving the middle of the key perfectly flat. The key is completely surrounded by a naked, rocky shore, excepting at one point on the west, where there is a triangular sand spit. There is more soil on this little island than I have seen on any spot, of a like size, throughout the Bahamas, consequently there is a luxuriant growth of trees, completely covering the key, excepting the exposed shore rocks.

So luxuriant, in fact, is this growth of timber, that when I first approached the key and saw the tree tops forming an elevation in the center of the island, I thought that there must be quitea high hill there, and was surprised upon penetrating the dense thicket which surrounds the outer borders, to find myself on a level plain. The soil is brown, and from it rise the tree trunks, many of which were from twelve to eighteen inches in diameter. These trees were, however, disproportionately short, while their boles were crooked and distorted in all imaginable shapes. Some lay prostrate along the brown soil for some distance, then shot up huge misshapen branches. Others leaned this way or that, sending down the buttressed roots so common to tropical trees. These misshapen branches and roots often resembled, quite closely, the arms and legs of men stiffened into wood. This resemblance to human forms was heightened by the whitish color of the trees seen in the dim half light of the thick wood, and the whole scene presented a striking realization of Dore's weired interpretation of the transformed sinners in Dante's Inferno.

There was not a vestige of undergrowth in this wood, so that the soil was everywhere plainly visible. After wandering about for a time I suddenly came upon what I saw at a glance was an old field, for the ground was completely cleared of the fragments of rocks which were plentifully scattered about on other portions of the key. Here they were neatly piled in heaps at regular intervals, leaving the intermediate space open for cultivation. But whoever cultivated this land must have abandoned it many years before, for the ground was covered with a similar growth of large trees as is found elsewhere on the island.

This cleared patch of ground occupied about half an acre, and I was quite pleased to find in its center an Indian well, almost a perfect fac-simile of the one at Allen's Harbor, excepting that the wall was on the western side. There was no water in the well.

As soon as I saw this excavation, it at once occurred to me that I was standing in one of the fields that had been cultivated by the Lucayan Indians, and that, save the changes wrought by time alone, the land had remained undisturbed, just as they had left it four centuries before. Upon further search around the margin of the old field, I found a heap of conch shells that had been opened as already described, and these offered additional proof of the past occupancy of the key by the Indians.

This key was frequently visited by the spongers years ago, and they have left conch shells opened in the modern way there, but I could not learn that any one knew anything about the key ever having been cultivated.

Among the conchs scattered near the sand spit was one heap that interested me greatly. These shells were very old, although not as old as were those with the circular holes, and they had been opened by the entire spire having been knocked off above the fifth whorl. When I showed these shells to our men they said at once that this was the method of opening shells practiced many years ago. This statement was also confirmed by other creoles who came to our camp. I have called this method the buccaneer method, and shall discuss the probability of its having been introduced into the Bahamas by these sea rovers later. See Fig. 5, C, for a cut illustrating this method.

While we were on Little Galden Key we were frequently visited by creoles who lived on Andros, and it was then that I first saw specimens of the Indian stone implements which the creoles call thunderbolts, of which I have spoken in the previous article. I had long heard of the thunderbolts of the creoles, but rather singularly had never seen one until they were brought into camp by the natives of Andros.

The most usual form of stone implement is a little axe made of a hard quartzose, stone, green in color, marbled with whitish. See Plate II. We saw several of these axes, and also one specimen of a kind of chisel made of a brownish quartz.

When I first found the Indian conchs I thought the holes might have been made by striking one shell with the apex of another, as the apex of a fresh conch fits the holes quite nicely, but when the little axes were brought in I saw at once, that this was the instrument used, sa will be seen by the following description of a specimen of an axe now before me. This was procured by the Maynard-Curtiss expedition in April, 1892, and was said to have come from Bigwood Key, near the well of which I have spoken. It is of a long oval form, brought to an edge on the broad end and to a point on the narrow extremity. It is highly polished, but contains a few imperfections which were in the original stone, that was probably a pebble. This axe is 3.75 inches long by 1.50 in the broadest part, and about .75 thick. The colored figure which I have given on Plate II is of the natural size.

A close examination of the points of the axes which came under my observation shows that they are worn in such a manner as to suggest that they had been used in making the holes in the conch shells. I find in every case the points of the axes fit the holes in the shells very nicely. Presumably the axes were fastened to a cleft handle, but I succeeded in making a hole in a fresh conch, similar to those in the Indian shells, by holding an axe head in my hand. The slightly triangular form of the holes may be accounted for by presuming that the shell was either laid flat on the ground, month down, or held level in the hand in a similar position. The stroke being given directly downward, and coming upon the spire on the slanting surface would make a hole a little wider on the highest part. As the holes are, as already shown, made with great regularity in the same relative position, this shows that the axe handles must have been finished with considerable care in order to insure a correct aim.

It is highly probable that these axes, finished as they now appear, were brought from some of the larger of the Antilles, as no stone of the kind of which they are made is found on the Bahamas.

While we were at Fresh Creek we were informed of two caves that were said to contain markings on the walls. The first which we visited was situated some three miles south of the creek, in a field, and proved to be a large pit hole with cave-like extensions in the walls The marks, which our guide showed us, were merely course lines caused by the action of water. The second cave opened out of the cliffs between Fresh Creek and Calabash Bay. Directly north of the creek the coast rocks are high, forming cliffs, often twenty feet in elevation and rising directly out of the water. These cliffs continue for about a mile and a half, then become broken and retreat a little way from the water, leaving a narrow, sandy beach which is seldom covered by the tide. A short distance north of this broken portion of the cliff is the cave. It has two mouths, both of which open into a separate gallery, each of which leads into the main cave. This chamber is about circular, some ten yards in diameter, and nearly ten feet high in the center, but with a sloping roof which approaches the floor in places. It is lighted from a hole in the roof on the west side.

The inscriptions in this cave proved to be nothing but some rude attempts at letter formation made on the walls of the north gallery, evidently a long time ago, by unskilled hands. We were repaid, however, for visiting this cave by finding several Indian shells in it, and the remains of a fire with cinders evidently very old. I know that this cave is seldom visited by the creoles, for we experienced considerable difficulty in finding any one who had ever been into it. Some knew where it was, but had never looked into it, and said that they would not enter it upon any inducement. The two men who did finally go there with us appeared by their manner when in the cave to be entirely unfamiliar with the place. Hence it is probable that the fire was not kindled there by creoles, but it might have been made by white men years before. I think it probable that the caves of the Bahamas were not as a rule resorted to by the Indians as constant residences, although as indicated by the shells in this one, they occasionally used them, possibly during hurricanes and other severe storms. At other times shelters made of palm leaves would have been amply sufficient for their needs. I found the Seminoles of Florida in winter, in small, rude, tent-like structures made of palmetto leaves, in a climate much colder, at that season than in the Bahamas. It is probably due to this simple method of living in a mild climate, where little or no clothing was necessary, that we find so few traces of the Lucayans on the Bahamas.

In the beginning of this article I stated that the Lucayan Indians were said to have been removed to Cuba by the Spaniards. They were not removed to Cuba but to what was then called Hispaniola, now Hayti. The story gathered from a variety of sources is as follows. Through a series of persecutions, partly to enforce labor, but mainly through sheer cruelty the Spaniards, living in Hispaniola, had, as early as 1508, succeeded in destroying two millions of Haytian Indians. Thus slave labor became scarce, and in 1509 King Ferdinand of Spain authorized Orvando, governor of Hispaniola, to procure Indians from the neighboring islands. The Bahamas were visited by the Spaniards, and, induced by the promise that they were to be taken to the heavenly shores, where the spirits of their ancestors were reposing, about forty thousand of the

Lucayan Indians were taken to Hayti, where they perished miserably.

At first glance this may seem a large number, but when we consider that the present population of the Bahamas is about forty thousand, and, as they but sparingly people the islands, it would seem that there must have been a greater number of Indians there at the time of the discovery of the islands, and that some must have remained behind when the removal took place. We find that in 1619 about four thousand of the Haytian Indians, a remnant of the immense population of Hispaniola, were in existance, and that, when through the efforts of the brave Las Casas (who was a strong advocate for the abolition of Indian slavery) peace was finally declared between Spain and the Indians, their numbers were not greatly diminished; while as late as 1750 a few still survived. Were there then no remnants of the Lucayans left? If so how long did they remain on the Bahamas, and what was the cause of their final extermination? I am still of the opinion, as previously indicated, that a thorough exploration of the interior of some of the larger islands, Andros, for example, would throw some light upon these questions.

As bearing remotely upon traces of the Indians, and in order to explain why I called the shells, of one of which I have given a cut in Fig. 5, A, buccaneer shells, I will give a brief history of the settlement of the Bahamas by the whites.

After the invasion of the Spaniards for the purpose of removing the Indians, no one appears to have visited the islands, excepting during the voyage of Ponce de Leon, who passed through the Bahamas in search of the Islands of Bimini and the Fountain of Perpetual Youth. The date of the settlement of New Providence by the English was 1629: from this time until 1703 the government of this island proved a veritable shuttlecock, being tossed from Spanish to English with the French occasionally taking a hand, until at last it was abandoned by all law-abiding men, only to pass into the possession of those free rovers of the sea,— the buccaneers. These people established many settlements throughout the islands, living mainly by plundering vessels on the neighboring high seas. In 1718 something like order was restored to the colony by the re-establishment of the British Government. But the buccaneers and their descendants remained upon the more remote islands, doubtlessly aiding in colonization, and thus impressed many of their peculiarities upon the succeeding generations who inhabited the islands. Probably the buccaneers frequented the entrances of all the Bights of Andros, hence we might expect to find traces of them on the neighboring land. and as it was on Little Galden Key, Middle Bight, that I found the conch shells in question, I have concluded that they were left there by buccaneers.

Following the establishment of order on the Bahamas, a better class took possession of the islands, and during our war for independence. and immediately after it. many royalists removed from the United States and settled in the Bahamas, taking with them considerable wealth and many slaves. It was at this time that the islands saw their most prosperous days. Cotton cultivation was begun on a large scale, but this did not succeed very well. and the whole enterprise received its death blow with the abolition of slavery in the British West Indies in 1834. The plantations were largely abandoned, and today it is not unusual to find, even on lonely islands, remains of well-built roads leading to the ruins of fine residences, all completely overgrown with bushes. Although many of their former owners left the islands, most of the negros remained, and intermarrying with the whites, produced the present race of creoles.

NOTES ON YOUNG BIRDS.

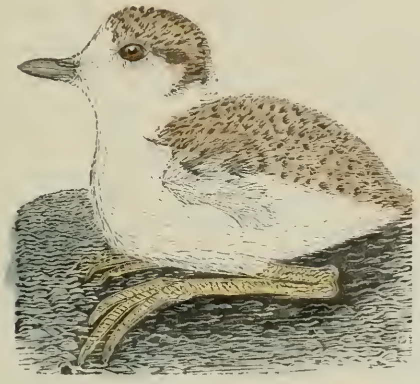
Wilson's Plover, Aegialitis wilsonius.

The two beautiful specimens from which the following description was taken were hatched from eggs obtained at Middle Bight, Andros, April 30, 1893, and which were but a few hours old when they died.

Lower parts, forehead, ring around neck, narrowing behind. and outer portion of wing, pure, snowy white. There is a spot behind eye. an elongated patch below this, and two spots on wings above, near body, black. Bill, black. Feet, yellowish.

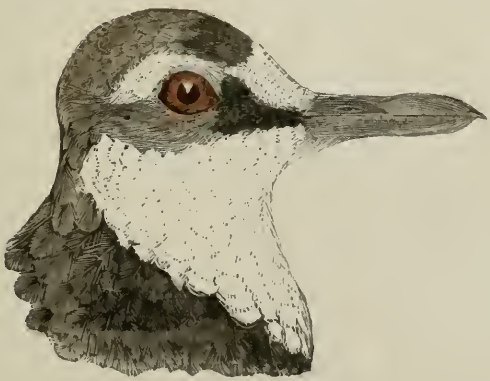
The bill is of about the same form as that of the adult, and the relative size is about the same. The most singular thing about the bill is the entire absence of even a trace of an egg tooth. Judging from the appearance of the bill, which is very hard for that of a young bird, the egg shell must be broken by the extreme tip, consequently the bird lies in such a position in the egg that the head and bill are not only held at right angles with its long diameter, as is usual in birds, but the bill must point directly outward. As the egg of Wilson's Plover measures only about 1.00 in diameter across the large end, and as the head and bill measure about the same in length in the newly hatched specimen, it will be seen that there is but little room for an impetus for an outward stroke with the bill; hence it is probable that the egg shell is broken by bits of it being pressed outward. When we come to examine

Fig. 6.



Wilson's Plover, two hours old.

Fig. 7.



Head of adult Wilson's Plover, taken at Middle Bight, Andros, April 30, 1893.

the chick in a nearly hatched egg, we find that the head is actually held in the position indicated above. In order that it may lie in this position it is bent forward upon the breast, and turned to one side, thus one eye (the right in the case examined) is pressed against the breast.

The legs, which are considerably larger proportionately than are those of the adult (2.25 long in the young, including toes, and 3.00 in the adult), are doubled, before hatching, with the feet pressed against the breast, while the tarsi-tibial joints extend back into the point of the egg.

Wilson's Plover lays its eggs upon sandy beaches, in a slight depressions scratched by the bird. They are clay-colored, finely spotted with black, hence it will be seen that they are extremely difficult to see, and the same is true of the newly hatched young. The young, as may be judged from the appearance of the cut of a specimen, given in fig. 6, run as soon as they are out of the shell, and probably gather food for themselves at once, as the hard, well developed bill would seem to indicate.

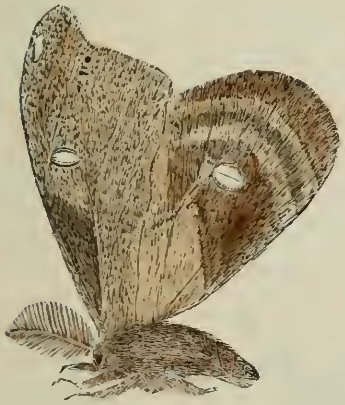
NOTES ON A SINGULAR SPECIMEN OF THE POLYPHEMUS MOTH, ATTACUS POLYPHEMUS.

In the autumn of 1893 Mr. D. D. Jackson called my attention to a naked chrysalis of the polyphemus moth, the larva of which never attempted to spin a cocoon. A few threads of silk were all that were ever produced by the caterpillar, but the hooks at the extremity of the abdomen of the pupa had become entangled in some cotton that was in the box in which the larva was imprisoned, and this cotton had become twisted together in such a manner as to resemble the button of silk produced by most butterflies. I could not, however, detect any silk among the cotton fibers, so that the resemblance was wholly accidental.

In spite of its naked condition, the pupa produced a moth early in March, and this moth was a singular specimen in several ways. Although a male it is very much smaller than the average size, and the color is much paler, with no prominent markings. See fig. 8. But one of the most peculiar things about it is the fact that the wings are unfinished; there are holes in them, as if there was not sufficient material in the possession of the moth to complete them. One of these holes may be seen in the apex of the fore wing in the colored figure. The pupa, of which I have given a cut in fig. 9, seems smaller and more pinched in appearance than in normal specimens.

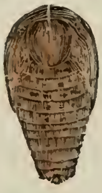
The caterpillar which was the origin of this moth was picked up by Mr. Jackson, to whom I am indebted for the privilege of figuring the specimens, late in the autumn, after the leaves had begun to fall, under a maple tree. It was small, and was evidently in a somewhat starved condition, thus the inference is that it had not gathered material enough to complete its entire transformation, yet succeeded in producing a moth, such as it is.

FIG. 8.



Singular polyphemus moth.

FIG. 9.



Chrysalis of same.

The specimens mentioned above were taken at Newtonville, Mass., but since the facts concerning them came to my notice, I have had between two and three hundred cocoons of the cecropia moth, which came from Michigan. They have produced, in most cases, small moths, a large percentage of which had abortive, much wrinkled wings. Many have also had holes in their wings, some of which were quite a half inch in diameter. While it is possible that all of these moths may be the the product of half starved caterpillars, I think it more probable that they owe their malformations to the fact that the cocoons have been kept too dry all winter. In the case of the polyphemus pupa, while the starving of the larva prevented it from spinning a cocoon, after having thus economized its substance, it ought to have produced a perfect moth.

Such would have perhaps been the case had the pupa been kept moist. A series of experiments with the cocoons of moths with the foregoing ideas in view, will prove interesting.

NOTES ON SOME WEST INDIAN SEA URCHINS.

In the following paper I purpose giving some facts regarding the habits, color when living, distribution, (both local and general) individual variation, etc. of the sea urchins that I have studied during my trips to the West Indies.

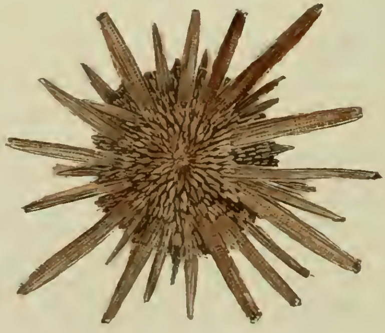
Club-spined Urchin.

CIDARIS TRIBULOIDES Lam.

FIG. 10, one half life size.

This singular urchin is known to the natives of the Bahamas as the rock egg, and is found common on the south side of Nassau Harbor, east of Spotters Key. It occurs on a bank which extends from the southern border of the channel to the island. The water on this bank is very shallow and is never anywhere over ten feet deep at high tide, and a portion of it is exposed at the lowest ebb along the land. The

FIG. 10.



Club-spined Urchin, Nassau Harbor, April, 1893.

bottom is covered with grass and among it live the club-spined urchins. They conceal themselves in the thick clumps of grass when the tide is falling, but emerge to feed when the water is rising.

These urchins appear to moult their spines a few at a time, new ones taking their places. The fresh spines are brown in color, whereas those that are older are covered with a thick coating of mud, held in place by what seems to be a small algae that grows upon the spines. The body is brown. Hence in general color this urchin resembles that of the brown grass and muddy bottom on which it lives, so that the animal is quite difficult to see. When taken from the water, the club-spined urchin stiffens its spines, thus assuming a regular form, and seldom attempts to move them again as long as it remains alive out of water, consequently when placed in the sun, dies with the spines in this regular position. It is very sluggish in habit, in fact, I have seldom seen one move, even when in the water. Average diameter, 4.00; maximum, 5.00.

I have occasionally found this species living beneath stones at Nassau, which is a regular habit with two smaller, but closely allied, species that I found, one on Inagua, near Mathewstown, and one on the reef south of Cayman Brac.

White-spined Urchin.

Hipponoe esculenta Lam.

Fig. 11, one half life size.

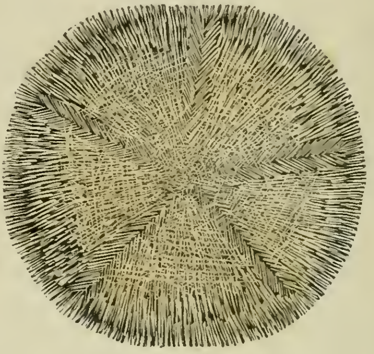
This short spined urchin is an exceedingly abundant species in the shallow water on the bank of which I have spoken above. When the tide is falling they gather bits of grass together with the tube feet and hold them against the spines, often concealing themselves completely in this way. This is not an especially active species, but the spines are rotated quite freely when the animal is recently removed from the water.

Unless the spines are set by placing the animal in boiling water, they droop and dry against the shell. When living, the spines frequently bend away from that portion of the test from which the tube feet arise showing the five rays, as seen in the cut. I have never found this urchin living naturally elsewhere than in the grass and in very shallow water.

The spines of this urchin are always white but the test varies from white to nearly black.

I found the white-spined urchin in the shallow creeks on the north side of middle Bight, Andros, but they were not abundant there. Average size, 4.00 in diameter; maximum size, 5.50.

Fig. 11.



White-spined Sea Urchin, Nassau Harbor, April 1893.

Variable Urchin.

Toxopneustes variegatus Lam.

This is a rare species, found associating with the white-spined. It has similar habits, but varies in color from reddish purple to olive green.

Oval Urchin.

Echinometra subangularis Leske.

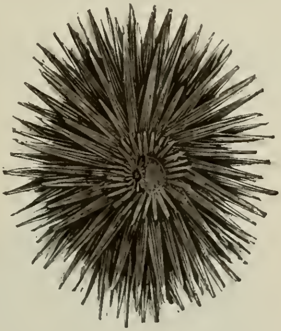
Fig. 12, one half life size.

This fine urchin appears to be universally distributed throughout the Bahamas where ever suitable localities occur. I have found it at Nassau, near the old magazine, at the east end of the city; on the east end of Hog Island; south of Fresh Creek, on Andros: very abundant at Inagua in front of Mathewstown; also common on the reefs south of Cayman Brac and Little Cayman.

The oval urchins live in rocks between tide marks, and exist in some places where they are exposed one or two hours by the falling water. When thus left exposed, they cling closely to the rock with the spines drawn down, and at such times, so tenacious is their hold that it is exceedingly difficult to remove them without breaking away the rock, but with the returning tide, they erect their spines, and in a measure loosen their hold; then, if taken unawares can be easily removed.

These urchins are black above, as a rule, but vary somewhat, certain individuals being brown of varying shades, but usually dark; all are inclined to be deep purple beneath.

FIG. 12.



Oval Sea Urchin, Nassau, April, 1893.

While it is not at all improbable that, like some allied species of echinoderms, the oval urchins sometimes excavate holes fo themselves, they more often occupy the natural cavities, which are so abundant in the soft, water worn, often honey-combed, rock.

At Inagua they often occupied basin-like cavities, which were much too large for them, and which were frequently so placed among the shelving rocks as to retain sea water even after the tide had ebbed away from them. Then each basin was not only occupied by an oval urchin, but also by a small species of scale shell (Chiton), and by a pretty little fish, which was reddish purple in color, of about the same shade as that of the lower side of the urchin. When disturbed, the fish would instantly take refuge beneath the urchin, gliding in easily among its spines. I presume that both fish and scale shell subsisted upon the remnants of the food that the urchin crushed with its strong jaws, while as seen, the fish found a refuge under the urchin, where it was secure from the attacks of most marine animals. The urchin submitted to the companionship of this widely different pair of animals because they were not annoying to it in any way, while on the other hand, both assisted in keeping the basin clear of minute algae, polyzoa, and other parasitical animals or plants. In this connection it is worthy of remark that the oval urhin is very neat about itself and surroundings, never being covered with any debris as in some other species of echinoderms.

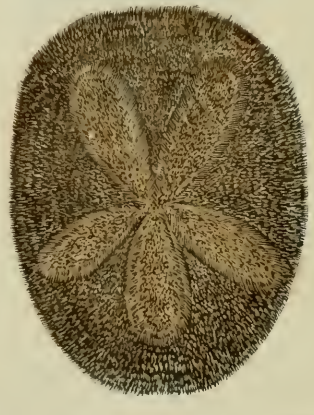
Biscuit Urchin.

ECHINANTHUS ROSACEA Gray.

FIG. 13, one half life size.

This fine urchin, which I found difficult to procure during the winter and spring of 1884, and winter of 1888, I found very abundant all along the south side of Hog Island and along the north side of Spotters Key in Nassau Harbor in April and May, 1893. Some specimens also occurred on the mud bank south of the channel with the white-spined urchins. They live in very shallow water and are occasionally stranded by the ebbing tide.

FIG. 13.



Biscuit Urchin, Nassau Harbor, April, 1893.

In habit the biscuit urchins are very sluggish, moving slowly by the aid of their short spines. During the ebb tide they cover themselves with debris, and then cannot readily be seen, but emerge at the beginning of the flood, perfectly clean, and can then be easily found. About May first, Mr. Curtiss saw a female in the act of depositing her eggs. These emerged in constant streams from the openings to the oviducts, which are situated in the middle of the star-shaped elevations. I was assured by the spongers that this species is migratory, and this was the explanation given for the appearance of such numbers in Nassau Harbor during the spring of 1893.

Color, living in young specimens is a reddish brown, gradually darkening with age to a beautiful seal brown. Average size 4.00 by 3.00 by 1.50. Maximum size, 5.00 by 4.00 by 2.00.

The biscuit urchin is one of the easiest of all the group to preserve, drying quickly in the sun being all that is necessary. The plates do not come apart readily, consequently dead, denuded specimens are often found, both in the water and on the beaches.

Beaver Urchin.

MEOMA VENTRICOSA Lut.

FIG. 14, one third life size.

This beautiful urchin occurs in not less than thirty feet of water, on sandy bottom, at a considerable distance from any rocks. Like the biscuit urchin, they are reported as being either migratory or of a wandering disposition, but always gregarious.

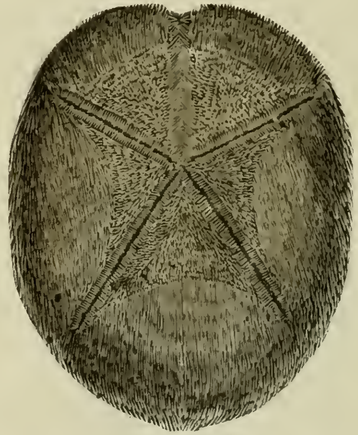
We found large numbers in April, 1893, on a flat sandy bottom, about midway between Hog Island and Salt Key, in a swift tideway. Here they buried themselves in the sand, going completely out of sight, then emerged very quickly as soon as the tide turned, and remained in sight until the next ebb.

The beaver urchin feeds on sand, evidently deriving nutrition from the minute algae and foraminifera with which it abounds. To preserve this urchin dry, remove the skin which surrounds the mouth and anal opening then with the aid of a hook the internal organs should be broken up, afterwards washed out by beating the animal up and down in the water. I have never seen a very young urchin of this species, nor could I learn that the spongers ever had. Nearly all of the specimens obtained had a small, brown species of crab clinging to the the spines on the lower side, sometimes two or three on one urchin.

The color, living, is seal brown above, greenish brown beneath, and when taken from the water the urchins give out a greenish yellow fluid, evidently from the tube feet. Average size, 6.00 by 5.00 by 3.00; maximum size, 7.00 by 6.00 by 3.50. The short spines of the beaver urchin are held nearly erect when the animal is in the water.

It appears singular that an animal of such a dark color as is this echinoderm, should live on a white sandy bottom, where it is conspicuous. The short spines cannot offer much defence, but the yellow fluid may be disagreeable to enemies; nothing, however, prevents the fatal attacks of an animal, probably some mollusk, quite likely one or more of the cameos (Cassis).

FIG. 14.



Beaver Sea Urchin, near Nassau Harbor, April, 1893.

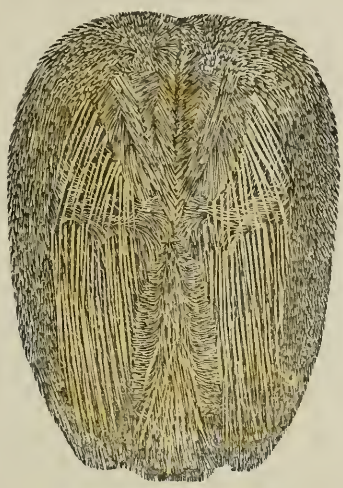
Cushion Urchin.

METALIA PECTORALIS A. Ag.

FIG. 15, one third life size.

This is the finest of all West Indian Urchins, and is also one of the rarest and most locally distributed. I know of but two places in which it occurs. One, a sand bar just off the western entrance of Nassau Harbor, and another near the western end of Salt Key. On both of these bars the water is at least thirty feet deep, even at low tide. The Cushion urchins are said to remain buried in the sand for nine months of the year, coming to the surface during May, June and July, and then during flood tide only. The bars on which they are found, being in exposed situations, are accessible only after a long period of very calm weather, consequently these fine urchins are very difficult to procure.

FIG. 15.



Cushion Urchin, near Nassau Harbor, May, 1893.

The color during life is pale yellow, deepining after cleaning, which is accomplished much as described in the beaver urchin. The average size of the female is 8.00 by 5.00 by 3.00 , maximum size, 9.00 by 7.00 by 3.25.

When the cushion urchin is first taken out of the water, the long slender spines of the upper side are held nearly upright, but are not rotated much. The short spines of the lower side are used as organs of locomotion, and even when on land tne animal progresses quite rapidly, gliding smoothly forward. I was much surprised to note the length of time that the cushion urchin lived out of water. Specimens caught before noon one day, lived until ten oclock the next morning, then had to be killed by emersing in alcohol. The beaver and biscuit urchins live out of water a few hours only, and the same is true of most urchins.

I was informed by the spongers that many cushion urchins are found dead on the bars, and several denuded specimens brought in showed that they had been killed by having a hole drilled in the lower side near the margin, evidently by the same mollusk that attacks the beaver urchin. One large specimen, now before me, has a hole near the front end about half an inch in diameter. This hole is similar to one that I found a queen cameo (Cassis cameo) in the act of cutting in the lower surface of a sand dollar (Echinarachnius), thus I judge that this mollusk may also devour both the beaver and cushion urchins.

Like the beaver, the cushion subsists upon the nutritious material contained in sand. I have never seen any small specimens whatever of this urchin.

Black-spined Urchin.

DIADEMA SETOSUM Gray.

This urchin is one of the most widely distributed species in the West Indies. It is abundant in Nassau Harbor; common on Andros at Middle and Southern Bights. It occurs at Allen's Harbor, and I found it remarkably abundant in the lagoon on the south side of Cayman Brac. This species always lives on sandy bottom, at depths varying from two to thirty feet. They are highly gregarious, assembling together in clusters consisting of from ten to fifty individuals.

The spines of this urchin are very long, measuring in large specimens, eight or more inches in length. They are very slender and exceedingly sharp terminally, thus whenever they come in contact with one's flesh they pierce it as easily as if they were needles. Then the hollow tips of the spines break off in the wound, causing intense pain. The sensation is much like that produced by the stings of the Portuguese man-of-war (Physalia), only the pain is, if anything, more intense. The flesh around the punctures becomes livid, accompanied by burning and shooting pains. The worst is over, however, in half an hour, especially if the injured part be kept immersed in salt water, then all disagreeable sensations gradually disappear, but the broken spines ought to be removed at once. The creoles are very much afraid of this urchin, saying that it springs upon them when they are wading in the water.

Although it is true that the black-spined urchins are very agile in their movements, when compaired with other echinoderms, locomotion being effected by the long spines, I have never seen one attempt to approach me voluntarily. In fact, although I have had a great deal of of experience with the species, in collecting largely among them, I have had very little trouble with them, more especially after I came to understand their habits. I have found that this urchin displays more intelligence than any other of the group that I have ever seen. When I was at Cayman Brac I had frequently to pass through large beds of this urchin in order to reach some coral that grew in the middle of a lagoon, south of the island. At first I would push the urchins out of my way with a stick, but I soon learned that if I moved slowly they would get out of the way of themselves, parting to the right and left to allow me to pass. At another time I saw several display what was clearly a spirit of investigation. I had taken a basket out into the lagoon, and after filling it with coral, allowed it to sink to the bottom while I went further away to look after more specimens. I was gone perhaps ten minutes, when, upon my return, I was surprised to find that a group of black-spined urchins, which lived on a sandy patch near, had come over to my basket. Some were climbing the sides: one or two were on the coral; while a single enterprising individual was perched on the top of the handle.

The usual color of adults of this urchin is black, with purplish on the lower side, near the mouth, but occasionally specimens have the spines of the lower side white banded, and I have on one occasion found a perfectly white individual. When these urchins are removed from the water the spines are waved about actively. Specimens are difficult to preserve with unbroken spines.

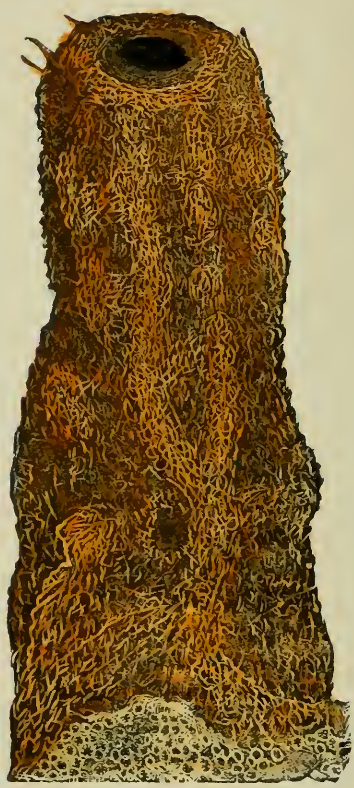
In addition to the species of echinoderms mentioned in the foregoing paper I have have found dead specimens of several other urchins, and also of one or two other species living, but at present have no notes of interest to communicate concerning them.

STUDIES OF NORTH AMERICAN SPONGES.

Introduction.

There is probably no group of animals which are so widely distributed, and which are represented by so many species as the sponges, which have received so little attention from naturalists. What is true

FIG. 13.



Tube Sponge, Verongia fistularis, Allen's Harbor, May, 1893.

of sponges in general is eminently true of the sponges of North America, especially of the West Indian and Florida waters.

Until 1864 our knowledge of the sponges of West Indies and Florida was confined to rather unsatisfactory descriptions of a few scattering species, by Lamarcke, Lamoroux, Schmidt, and a few others; then appeared the "Spongiairie de la Mer Caraibe" by Duchaissing and Michellotti. So unworked was the field examined by these authors, that out of about one hundred and twenty forms described by them, something like one hundred were actually new to science. In my studies of West Indian sponges, I have been greatly aided in the identification of species by the description and figures published in this work, all of which I have found amply sufficient to enable me to decide unhesitatingly as to the identity of any species with which I am familiar, that they have described. I am aware that my experience with this work is somewhat at variance with the expressed opinions of some other authors, but it must be borne in mind that Duchaissing and Michellotti had the advantage of studying sponges in their native element, and that both their descriptions and figures are made in most cases from living or fresh specimens, and that I, having had a similar experience, can more readily comprehend their meaning, than others who have never procured living specimens By these remarks I do not wish to be understood to say that I fully endorse the systematic arrangement of these authors, or that I consider all the forms described by them as species, as entitled to specific rank, but I do mean to say that I consider that, under the circumstances they have written a most excellent work and one well worthy of the careful attention of students in this department of animal life.

Following this work, we find a few more scattering descriptions of West Indian Sponges mainly by Messrs. Bowerbank and Carter, until in 1875, the first part of Prof. Hyatt's careful "Revision of the North American Poriferæ" appeared, followed the next year by the second part.

Although most lamentably Prof. Hyatt's work has never extended beyond the horny sponges, considering the material he had in hand, he has done his work very thoroughly, insomuch so that there are few forms which he did not recognize in some way that I have found in the West Indies and Florida. He described several new species, most of which as will be seen in the following pages, I can endorse; his errors are in the main due to conservatism, (a safe side as a rule, with a scientist if indulged in with moderation,) and to the fact that he was unfamiliar with the living sponges. It goes without saying, that his work has been of utmost value to me, especially as I have had, through his kindness, access to his types which are deposited in the collection of the Boston Society of Natural History.

The next work of importance wherein we find any mention of North American Sponges is Dr. Lindenfeld's Monograph of Horny Sponges, published in 1889. While acknowledging a great superiority of this work over any that has previously appeared, as far as Australian and Mediterranean Sponges are concerned, I cannot help feeling that if Dr. Lindenfeld had had an equal experience with living West Indian sponges, he would have most undoubtedly expressed a different opinion from what he has, regarding some of the species that he mentions, or would have recognized several perfectly valid species, described by Prof. Hyatt. which he ignores.

I began to pay attention to sponges in 1870, when I made a large collection on the Florida Keys, and since then, I have collected and studied sponges whenever opportunity offered, during my various trips toFlorida and the West Indies, always with the intention of publishing my observations, in some way, and as I now feel that I am in a position to throw some light upon several disputed points, begin a series of articles upon the subject.

My method of studying sponges has been similar to that which I have practiced in all other branches of zoology in which I have worked. I have at first, independently decided as to the validity of a given species, without attempting to find out whether it has been named by any one or not, then I have endeavored to identify it with some published description; going backwards always to the original, and thus throughly satisfying myself that the species I have in hand is the one which had been described. On points of structure, etc, as will be seen, I have been equally careful.

The skeleton of the horny sponges presents some excellent specific characters, if closely studied, but the characters which I have found of the most value, are, the general form when living, habit of growth, internal structure, position and depth of the tubes connecting with the excurrent water system, and general internal structure, I also find that elevations or depressions on the surface often offer some valuable specific characters, but these last mentioned should be used with extreme caution. as in some species they are the most variable of characters, falling within the range of individual variation.

Of course. in deciding upon the validity of any given species or subspecies, it first becomes necessary to ascertain the range of individual variation. It has become usual, of late years, for naturalists to regard many forms of animal life as being in a transition stage of existence. Or, in other words, that one species is, through the extremes of individual variations, passing constantly into some other specific form, while there are thus always connecting links in the chain of transition, which often remain in existence for a greater or less period of time. This may be the case somtimes. but I do not think that this is the usual method by which species make their appearance. I have elswhere remarked that I believe that new species, about to be evolved from an old one, are usually indicated by the extreme oscillation of individual variation, but just as soon as an individual, or a group of individuals, which have varied in any direction, are placed under different environments. in any way, the characters, which, at first, rendered them only slightly at variance with the parent stock, speedily (possibly in three or four generations) become exaggerated. This exaggeration gives rise through correlation, or what not, to other characters not possessed at all by the parent stock; thus a species comes into existence with characters so fixed that there can be no return to the original stock.

To be sure, in the new species reversions towards the parent stock will often occur, frequently for many generations, that will so closely approach the presagement characters, which caused the origin of the new form, as to cause some confusion, but in deciding upon specific rank we should always remember that such specimens are not true intergrades. I think as far as my experience goes in the study of closely allied forms, that true subspecific intergrades are the exception rather than the rule; of course some groups of animals are much more plastic than others, and from these, species become envolved much more readily than from others not as plastic, and we must look for much more closely allied species among the plastic groups, than among others from which fewer species are being evolved. It must also be kept in mind, when studying groups with closely allied species, that the value of comparatively slight characters becomes greater in proportion, and should be held in equal consideration with more prominent characters in species which stand more widely apart.

At present in presenting these studies of the sponges to the public, I shall be unable to arrange the species in a systematic manner in any just degree, but shall take up different genera, or even separate species, or facts regarding different species, as I can best bring my notes together.

The Genus Verongia.

VERONGIA Bowerbank, Annals and Magazine of Natural History: 1841. Type, Verongia fistularis.

LUFFARIA Duch, et. Mich. Sponge. Mer. Carb. 1864.

APLYSINA Lindenfeld, (in part). Monog. Horny Sponges. 1889,

GEN. CH. Form, varying from tubular to branching. The color living, in the species that I have seen, is either bright orange yellow, purplish or bluish, and Lindenfeld says the same of those species which he has examined in Australian waters: but Duchaissing and Michellotti give one species (V. sebac) as being black, and another (V. rupicola) as being brown. All, when dried with the sarcoid adhering, become black.

When living, all are well covered with sarcoid, and are very smooth and glossy externally. The water system is variable and will be described under specific headings, but one constant character in this system is a tube which penetrates to a greater or less depth into the body of the sponge, and into this tube the excurrent system opens. This tube reaches its greatest size in V. fistularis and is smallest in the branching species. One of the most remarkable characters of this tube is a kind of membrane, of greater or less extent, (varying in this respect individually) which partly closes the mouth, (see plates 3 to 6 and figs. 13 to 18) and which forms part of the smooth lining membrane. But this is described at greater length under specific characters.

The horny skeleton is made up of fibers, which become quite stiff and rigid in old specimens and which anastomose at irregular intervals, (see fig. 21 to 26) in all directions forming meshes, which vary in size from two to five hundredths of an inch across.

Increase of the skeleton takes place by division of the termination of the hollow membrane of the fiber, before it becomes coated with horny matter, always at the extreme tips of the growing twigs (See fig. 25.). The new twigs, thus formed, after growing a short distance, either anastomose with the tips of some other twigs, in which the membrane is exposed, or become arrested in growth, in which case the open tip of the membrane, or inner tube, is sealed by the horny matter which encroaches upon it from behind, shortly after it is formed. I have, however, discussed this matter more fully under specific headings, as the method of formation appears to vary somewhat.

The color of the skeleton varies somewhat with the age of the individual, but the lining membrane is always yellow, and the horny matter deposited on it is of an amber color, of some shade.

All of the members of this genus that I have seen living, grow on rocks or coral, and are seldom, or never, parasitic upon other sponges. Neither are they, as a rule, attacked by parasitic sponges, and when, rarely, one is attacked, the sponge appears to be rendered unhealthy and produces abnormal growths.

In regard to the depths of water inhabited by them. although I have never seen a Verongia exposed by the falling tide, some of the species grow very near low water mark, whereas others occur at a depth of thirty feet. There is little or no individual variation in regard to depth. each species occupying its own particular zone. None of the species occur directly in swift tideways but live in comparatively quiet waters, where the force of the current is broken by reefs, rocks, points of land, etc.

This genus was first reconized by Bowerbank in 1841, in the Annals and Magazine of Natural History,with Verongia fistularis as a type. His generic characters were based largely upon the hollow fibers of the horny skeleton and irregular anastomoses of the fibers.

Duchaissing and Michellotti in Spongiarie de la Mer Caraibe, 1864, without mentioning Bowerbank's name at all, rename the genus Luffaria, on account of the resemblance of the horny skeleton of some of the species to the interior of a kind of cucumber or gourd of the genus Luffaria, known as the vegetable sponge. Their generic characters are derived from the form, color and general appearance of the horny skeleton; the peculiarly characteristic color of this is mentioned, and its round, thick, coarse fiber is given, but nothing is said of the hollow in the fibers.

Hyatt in 1875 recognises the genus, which Bowerbank named Verongia, basing his characters wholly upon the hollow fiber, which is given as proportionately smaller than in Aplysina, and its irregular anastomosis.

Lindenfeld in 1889 does not see fit to recognize the genus, saying that it cannot be separated from Aplysina in which genus he also includes Hyatt's genus Dendrospongia, thus including in one genus not only three genera as recognized by Hyatt but also two families, namely, Dendrospongiae and Aplysindiae.

Although I am not at present prepared to discuss the question of the higher groups I am thoroughly satisfied as to the desirability of maintaining the rank of Verongia; indeed, it seems to me that this is one of the most clearly defined generic groups that we have among sponges.

The nearest allied genera to Verongia are Dendrospongia on the one hand, and Aplysina on the other. With both, Verongia agrees in the general bright colors of members of the genus, and in having the horny skeleton abundantly covered with sarcoid. and in also having much the same habit of growth, the species of all three genera often growing side by side. With Dendrospongia there is more similarity, as members of this genus, also have an irregular anastomosis of the fibers of the skeleton. Aplysina, however, has a very regular anastomosis in-so-much so that the interlacing of the fibers often form honeycomb-like cells (See fig. 16 where is given figure of a skeleton one-forth life size.) From both Dendrospongia and Aplysina, Verongia differs in more regular form, more closely meshed skeleton, causing the dried undenuded sponge to maintain its form better than in the members of the two other genera.

With other horny sponges there is scarcely need of any comparison, There is, to be sure, a superficial resemblance between the tubular forms of Verongia and some of the tubular members of the genus Stelospongos, especially as some of these sponges also have the closing membrane to the central tube. This is true of S. cribriformis, of which I give a cut in Fig. 27. Dr. Lindenfeld remarks, that the Spongia fenestirata of Duch. and Mich. may be a Verongia; but this is most undoubtedly a Stelospongos, closely allied to S. cribriformis, evidently differing from it in life, in being black instead of olive green.

In the branching species of Verongia there is, perhaps, the slightest superficial resemblance to the cord sponge, Funiculea purpurea, (Hircinea purpurea Hyatt.) But this last named species is one of the strongest marked species which we have among West Indian sponges; so strongly marked, in fact, as to present good generic characters, and I have ventured to place the species in a distinct genus (Funiculea), yet Lindenfeld, evidently through unfamiliarity with the species, has given it as a synonym of a branching species of Verongia!

Briefly summarized, we find that among West Indian sponges the genus Verongia stands clearly separated, having but two closely allied forms, namely, Dendrospongia and Aplysina. Both of these have a much more loosely constructed skeleton and the sponges are much softer in life, the frame work being unable in many cases to support the sarcoid when taken out of the water, and unless dried with great care they are apt to melt into shapeless masses; whereas in all species of Verongia the skeleton is firm enough to support the sarcoid, when dried in the sun with ordinary quickness. Verongia, as will be seen by the number of specie given, is a very plastic genus, evidently evolving forms quite readily.

ORANGE TUBE SPONGE.

Verongia fistularis.

Plates III, IV, V, VI, VII and Fig. 13 to 26.

Spongia fistularis, Pflanzenthiere; Vol. II, page 28, plates XX, XXI. XXI A : 1794.

Luffaria fistularis Duch. et Mich; Spong. de la Mer. Carib. p. 60 ; 1864.

Verongia fistularis Haytt; Rev. N. A. Porif., Part I, p. 402 (in part) 1875.

Aplysina fistularis. Lindenfeld ; Monograph of the Horny Sponges, p. 221. 1889.

DESCRIPTION.

Sp. Ch. Large, prominent sponges, with the form cylindrical and tubular for their entire length. Tube, occupying more than one half the diameter of the sponge, hence the walls are moderately thick. Outer surface roughened by circular projections, that extend outward about one half the thickness of the walls.

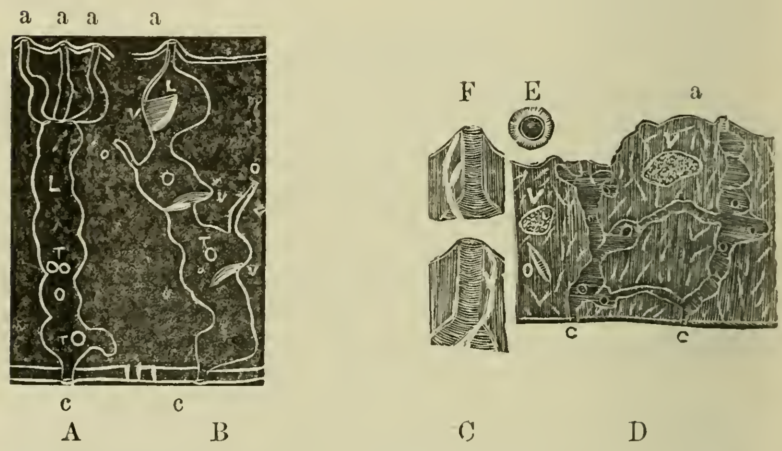
Structure. In life this species is fleshy, yet is soft and compressible, but when dried with the sarcoid on, it is very rigid. The water system is comparatively simple. On the outer surface of the sponge are small tubercules about .05 in diameter (all measurements are in inches and in hundredths of inches.) by about .01 high. In the center of each of these tubercules is an opening, some .02 in diameter. This opens into a cylindrical tube some .10 long. The walls of this tube are composed of rather tougher material than the lining membrane of the water system, and may not only be removed entire, but also often remains intact after the sarcoid has been marcerated away. (See fig. 14 A. B, where I have given an enlarged cut of this tube; C, is its opening.) As seen, this orifice is not guarded by any sphincter, or other membrane or valve. In fact, the rigidity of the walls show that the mouth of the tube is constantly open.

The incurrent tubes open into cells which vary in diameter from .10 to .25. Usually the upper cell is a little longer than wide, and opens into another similar cell, deeper in the walls of the sponges, and this into another, and so on through a series of from four to seven, or even more, the last resting against the lining membrane of the central tube

(See fig. 14 a, a, a, a, being the incurrent tubes with the cells below them. Sometimes the opening between the cells is partly closed by a kind of translucent tympaniform membrane, that is stretched from one twig of the skeleton to another. (See fig. 14, B, v, v, v, where I have given a cut of these tympaniform membranes enlarged about three diameters, and as will be seen the forms varies).

From the sides of many of these cells, open small tubes which communicate, often in a winding manner, either with some other similar tube, or with another system of cells, but without any regularity. (See fig. 14, where I have given two of these tubes, connecting two cells systems, and the black dots in the cells show the entrance to other tubes, and others may be seen at A, T, T, and o, o, in B.

Fig. 14.



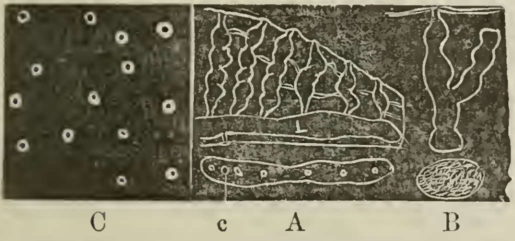
Water system of Verongia fistularis, considerably enlarged. Allen's Harbor. May, 1893.

The surface of the membrane lining the great central tube of the sponge is smooth, and scattered very irregularly over it are openings, which are not situated upon tubercules, and which are provided with a kind of sphincter muscle, by which the opening is closed, in fact the opening appears to remain closed, unless opened by pressure of fluid from within. These are the excurrent openings, and they communicate through a short cylindrical tube, having soft walls, often directly in contact with the last cell of the water system, (See c in fig. 14, D, and also c in A and B.

The incurrent orifices are about .25 apart, on the average, and are scattered quite irregularly over the surface, varying in number from 12 to 16 to the square inch, (See fig. 14, where I have given the actual number to a square inch of the surface of a cylinder, which was about eight inches long, showing the true position of the incurrent openings and their number, but considerably enlarged.

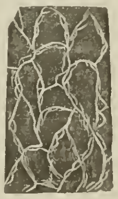
On the other hand, the excurrent openings are not numerous and are seldom or never found near the mouth of the great central tube. Thus it will be seen that, from necessity, one system of cells, which has no direct communication with any excurrent opening, must empty its contents into another system that does, and this is frequently the case. There is another method, however, which I have found near the termination of a cylinder, that was eight inches long. Here one excurrent tube opened into a long, tubular cell, that, extending upward, received the contents of no less than six cell systems, each successive one growing shorter, as the sponge grew thinner toward its termination. All of these cell systems opened in a line on the inside, but became diffused somewhat externally to meet their respective incurrent tubes. This should be kept in mind in consulting the diagram at fig. 15, where this system is given at A.

FIG. 15.



Water System of Verongia fistularis Allen's Harbor. May, 1893. Enlarged.

FIG. 16.



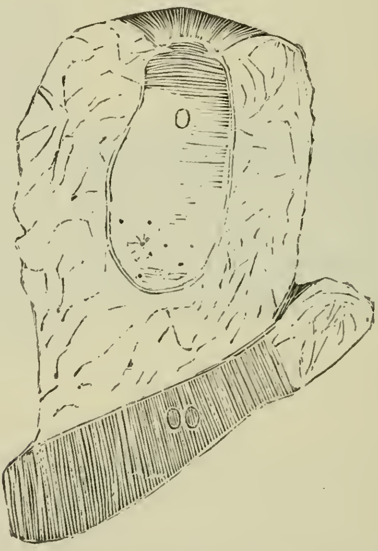
Skeleton of Aplysina gigantea. Bahamas, 1893. Life Size.

L shows a side view of the elongated chamber, lying just within the skin of the central tube, with the six cell systems opening into it, and below it is a top view of the same, all of the circular dots being the position of the incurrent communication with the cell, excepting c, which is the excurrent opening in both top and side views. Another method of the concentration of the incurrent tubes may be seen at fig. 14., A, where three incurrent tubes, a, a, a, open into a common water system, L, which is quite wide. The actual number and position of the excurrent openings in one half of the central tube of a small life size sponge may be seen at fig. 17, near the bottom of the tube, O.

There were eight of them (represented in the figure by the dots) in this half, and about the same number in the other half, and none at all near the mouth of the tube, and this is quite usual in this species of Verongia.

The method of formation of the water system is difficult to make out, but a small tubular system appears to penetrate through the sarcoid at the extreme end of the cylinder, among the growing fibers of the skeleton, then the tough incurrent tubes appear to be formed in the skin of the sponge, outside the lining membrane and closing membrane of the mouth of the central tube, and then penetrates to the nearest newly-formed small tube, that connects with the older water system. Then the small tubes become gradually enlarged into the regular cellular system.

Fig. 17.



Section of a small Verongia fistularis, life size, which grew from a larger cylinder, a portion of which is given at o, o. Allen's Harbor, May, 1893.

The smooth lining membrane of the central tube is about .10 in thickness, and near the terminal end of the tube, it is projected forward to form the circular closing membrane, which, at the point of jointure with the regular lining membrane from which it arises, is considerably thickened, but becomes thinner in the inner edge. See fig. 17 and 18 above o, both figures being life size.

COLOR. Living, brilliant orange yellow, quickly changing to jet black after being taken from the water and this color is retained if the sponge is quickly dried in a pure, hot atmosphere. In alcohol the sponge externally is dull black, with the interior grayish yellow.

DIMENSIONS.

Length of type cylinder, 7.50; diameter, 1.50; depth of central tube, 7.25; diameter of tube, .75; width of closing membrane, .20; shortest cylinder, .80; diameter, .75; depth of central tube, .40; diameter of tube, .30. Longest cylinder, 13.75; diameter, 2.50; depth of central tube, 13.25; diameter of tube, 1.65. Largest diameter of any cylinder 13.60; diameter of its tube, 1.75.

BUD PROPAGATION.

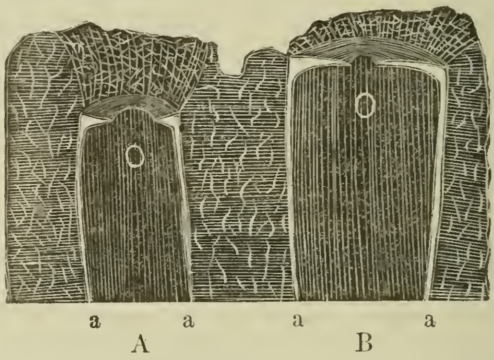
Budding takes place, normally, at or near the base of some cylinder (See Plates V and VII). The origin of a bud is first indicated by the thickening of the skin of the sarcoid on the surface at some particular point, usually in some depression. The thickening of this skin appears to check the growth of the sarcoid in that direction, as far as the thickened skin extends, and consequently the growth of the accompanying skeleton, but there is still an outward growth around the area formed by the thickened deposit. Thus a tube is begun, which at first grows wider (see fig. 20, B. o. where a life-sized young sponge is given), but after assuming the length of three inches or more, continues about the same diameter (See figs. 17, 18 and 22). Often, however, especially should sand gather in the bottom of the tube, an extra membrane or skin is thrown across the tube, accompanied by sarcoid, and followed by the production of horny fiber, and the narrow, basal portion of the tube is cut off, thus it becomes about the same diameter for its entire length.

The buds sometimes form directly from the body of a cylinder or at some distance from it through the spreading out of a comparatively thin portion of the sponge over any material upon which it grows. See Plate V, where the new sponge on the right has formed some distance from the main colony, and Plate VII where a bud has formed under similar circumstances to the left, whereas on the right of this same sponge a bud has formed close to the cylinder. [Note. All of the plates of sponges in this number are made from photographs taken by Mr. Walter M. Hastings, of West Newton, and are about one half life size.]

BUD VARIATIONS AND ABNORMAL GROWTHS.

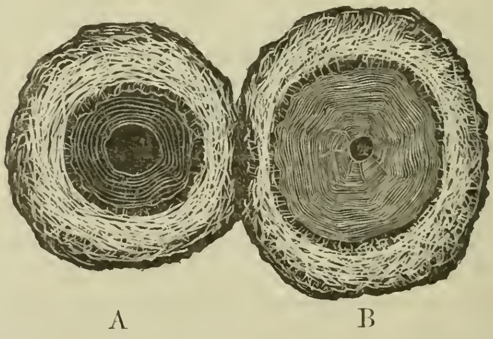
Any variation from actual budding at the base, either on or near a cylinder is rare. One of what is the most extreme departure from this rule occurs on a single cylinder seven inches high, the bud appearing about half way up the side. Upon examination I find that this sponge has been injured, two holes having been broken into its side near the base, admitting sand, with which the tube has been

Fig. 18.



Section of Verongia fistularis O, tube, above which is the closing membrane. Allen's Harbor, May, 1893.

Fig. 19.



End of the same sponge given in fig. 18, showing closing membrane and its orifice.

completely filled. A section shows that a partition has been formed above the sand; thus the bud has originated at what is really the base of the cylinder. (See fig. 22, B shows the cylinder, with the hole at d, filled with sand; T, is the tube; a, the partition, e, the bud.) On account of this abnormal growth the tube of the cylinder is slightly contracted at its termination. The bud is given at A, life size, and the relation of its tube, T, with the walls of the parent cylinder, c, may be seen. This bud had the closing membrane quite well developed.

Another case of eccentric budding is in a sponge nine inches high, where a bud has originated some two inches from the base; but upon making a longitudinal section of this specimen I found that the central tube of the large cylinder was abnormally narrow for two inches of its basal length, being only about a half inch wide, and the origin of the bud is just above this narrow portion.

In a sponge having two cylinders, one seven and the other four inches high, two buds have appeared between the cylinders, one above the other, the highest being 2.50 from the base and the other is directly beneath it; but both these buds adhere to the largest cylinder and I find by measuring the depth of its tubes that the lower bud is really basal. Furthermore, the walls of the sponge are abnormally thickened — at the part where the buds appear, and as both the buds are of the same size they probably originated about the same time if not simultaneously and their appearance was probably induced by the abnormal thickness of the walls at this point.

In another case in a group of three cylinders where the buds have appeared above the base, I find that the Verongia has been attacked by a parasitical sponge of the genus Funiculea. Another specimen, also having three cylinders, which has been attacked by a parasitical sponge belonging to the Spiculiginous group has several oscules formed, but they are very shallow and are quite similar to those found in the branching species of the genus Verongia.

In another sponge which was of an unknown length, of which I have a section about a foot long, in which two or three tubes have become twisted and distorted by the clinging of a parasitical sponge, buds and branches have appeared in several places, not at all near the base.

Verongia fistularis is singularly free from the attacks of parasitical sponges and it is never parasitical itself upon other sponges, and when attacked by a parasite disturbances occur which cause both abnormal budding and growths, some of which may be reversions, while as will be seen in the following pages the skeleton is also affected.

From my observations cited above it will be seen that basal budding is the rule and that any departure from this is caused by some abnormal condition in the system of the individual sponge in which it occurs.

I have never been fortunate enough to procure a very young sponge of this species single, showing its first origin, but judging from specimens examined, it is evident that two, three and (rarely) even four cylinders start side by side; sometimes growing upwards together, adhering for their entire length (See Plate III). Or they will grow apart as in the left hand cylinder in Plate VII. When two adult sponges of this species come in contact, however, their fibers will not combine by anastomosis as they do when young. But on the other hand when a young growing sponge comes in contact with an adult the skeletons do anastomose, but in a different manner than when both are young. (See remarks upon this subject giving reasons for this under head of Skeleton). I have seen two or three specimens which have given me reason to think that two cylinders, belonging to separate colonies, will never unite by anastomosis when they come in contact at any age. I have placed a specimen of this description in the collection of the Boston Society of Natural History. The matter, however, requires more study for the absolute confirmation of this theory.

Usually when cylinders grow side by side the thickness of the wall between them is about equal to the outer wall of one cylinder, but in some cases it is much thinner, and in one double tube is reduced to about .25 in thickness with very little horny skeleton. In spite of this thinness of the dividing wall these tubes have remained separate for their entire length, about nine inches, and this appears usual. Indeed, as a rule there appears a decided tendency for adhering tubes to separate, after growing together for a time, as shown in the type Plate VI, and become free at their summits. I have seen many instances of this. As exceptions to this rule I have seen one case where double tubes after remaining perfectly separate for eight inches of their height gradually combined into one and have grown as one tube for seven additional inches, The tube has not lost the groove which showed the original separation externally and become perfectly cylindrical until within 3.50 of the summit. Externally the double tube at the base is about 3.00 wide by 2.25 at the summit. The single tube is nearly 1.50 in diameter with very little trace of a closing membrane. It is a significant fact that, after becoming one tube, this sponge has sent up a third cylinder, which is about 3.00 long and 1.00 in diameter. This arises from the sponge matter that has spread along the coral support from the base ofone of the double tubes.

Another case is a specimen which has kindly been given me by Dr. T. W. Thorndike. This consists ofthree tubes all of which are of one length, about 7.00, and all of which adhere closely for their entire length and toward their summits they are gradually contracted so that two of three tubes have gradually merged into one and the third appears to be also about to join the others had the sponge lived long enough. There is a trace of a closing membrane in all the tubes. Both of these exceptional specimens were taken at Allen's Harbor, in May, 1893.

VARIATIONS AND OBSERVATIONS.

In writing this article I have made notes upon upwards of three hundred and fifty specimens of the Orange Tube Sponge and as I write I have over one hundred and fifty selected specimens before me, dried with the sarcoid on, and many skeletons, hence I have ample opportunity of studying the range of individual variation.

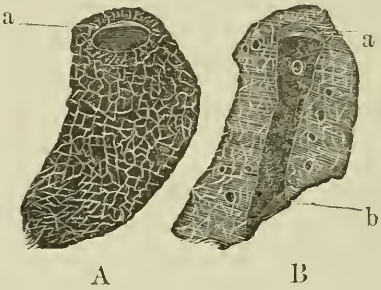
Variation of Form. The most obvious variation is in the number of cylinders constituting one colony. Although there is a tendency to form groups of more than one cylinder, I find that out of one hundred and fifty undoubtedly unbroken sponges, eighty are single, thirty-four double, sixteen are made up of three cylinders, fourteen of four, two of five, two of six, one of seven, one of nine, and one remarkable specimen, now in the collection of Dr. T. W. Thorndike, of Boston, is composed of nineteen distinct cylinders.

It is worthy of remark, that in the sponge with nine cylinders there is one only that measures five inches in height, all of the others being somewhat shorter, and the cylinders in the large sponge in Dr. Thorndike's collection, are just about six inches high, yet, judging from the walls of the tubes in both of these specimens, they are undoubtedly adult sponges. Other sponges having several cylinders are never very high nor are the tubes very large in diameter.

The tallest sponge of this species that I have ever seen is a single tube, and the one with the thickest walls and largest diameter is also a single cylinder. This specimen is figured on Plate IV.

The next most striking variation is in the comparative smoothness or roughness of the surface of the cylinders. Very young sponges are, as far as I have observed, smooth. (See Plates V and VII and fig. 20.) and this smoothness sometimes persists through the life of the sponge. Thus the large sponge figured on Plate VII is smooth, having nothing worthy of being called a protuberance on any portion of the long cylinder. Such sponges are, however, comparatively rare, amounting only to about five per cent. of the whole.

Fig. 20.

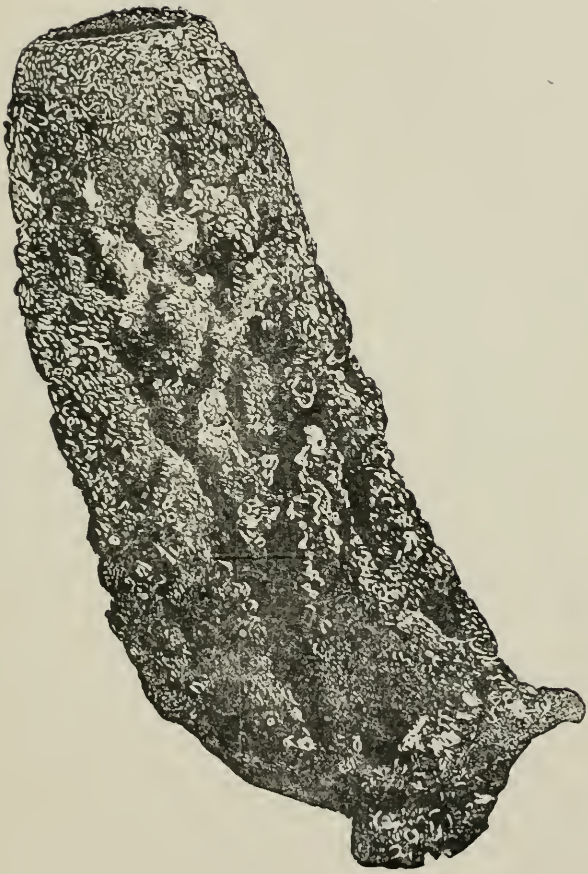


Young Verongia fistularis, life size. A, whole sponge; B, section; a, terminal closing membrane; b, extra closing membrane in broken portion.

Rough specimens are the rule. I have selected for a type a specimen having circular protuberances with deep pits in the centre (See Plate VI) as representing the average sponge of this species. From these protuberances often grow projections, usually blunt and rounded terminally, that sometimes after growing a short distance, turn upward, thus giving the sponge a singularly rough appearance. In the specimen given on Plate IV these upward-growing projections are partly developed. Occasionally these projections become developed to a remarkable degree, and I have seen the free terminations project .50 with a diameter of .40. In these large examples there is sometimes an indication of a terminal oscule, but I have never seen a bud arise from them. Although there are incurrent openings on them, these always penetrate to cilia cells in the interior of the main body of the sponge, and emerge by the regular excurrent system in the great central tube.

Between this extremely rough surface, with its upward-growing projections and the smooth form there is a complete gradation of individuals, exhibiting every stage of roughness or smoothness; thus in

PLATE IV.

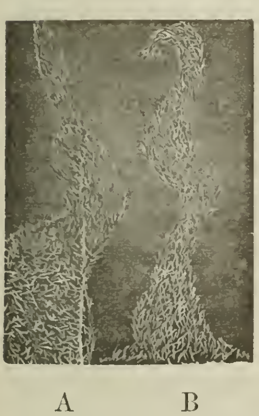


VERONGIA FISTULARIS,
One half life size. Very rough form, color of dried specimen
Allen's Harbor, April, 1883.

these characters it is impossible to find any indications of specific differences, as they merely represent the extremes of the oscillations of individual variation. The specimens given on Plates III and VI are typically rough; Plate IV shows a specimen much rougher, Plate VIII one somewhat smoother than the type. On Plate V the larger cylinders show some incipient projections, but none of these appear on the very smooth sponge given on Plate VII.

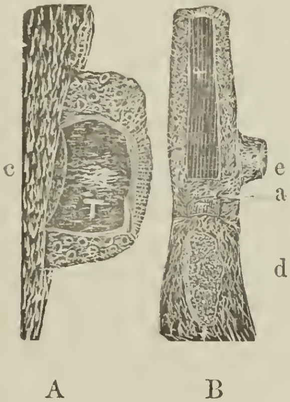
I must now call attention to another class of protuberances: these are long, slender filamentous processes, which, although not always present, are liable to grow anywhere on the sponge. Specimens of these filaments are seen on the sponge given in fig. 13, page 48, near the termination on the left of the central orifice.

Fig. 21.



A, Normal filament of Verongia insularis;
B, Unusual filament of V. fistularis.

Fig. 22.



Illustrating abnormal budding of Verongia fistularis, A, bud, life size; c, walls of parent tube. B, parent tube, reduced size; e, bud, a, partition; d, broken area; T, tube in both.

The longest filament that I have seen grows from the base of a sponge and measures 2.50 long by .25 in diameter. (See fig. 21, B, where I have given a life size figure of one of these filamentous projections). The sponge on which this grew is a double tube, the largest of which is 9.00 high so that even a process of this description is of comparative insignificance. There are three only of these processes on this sponge, all at the base. Sometimes these processes are very slender, and in one large specimen they are very numerous. forming a moss-like anastomosing mass on one portion of it.

Variation in structure, consists of a greater or less number of incurrent openings, and consequently of cilia cells and excurrent openings. When two sponges adhere together for their entire length. the excurrent openings do not occur on the side of the central tube nearest the adhering sponge.

The closing membrane at the termination of the central tube is somewhat variable in its position. It is usually quite near the extremity of the tube, not as a rule over .10 from its termination. In one double sponge, however, I find that while in one cylinder it is in it snatural position, in its closely adhering neighbor it is at least .40 from the top. (See fig. 18, where I have given a life-sized section of these tubes: that at B has the membrane in its normal position, while that at A has it much lower.) The width of the membrane varies greatly; sometimes there is a mere trace of it, but it is usually moderately well developed. The largest membrane which I have ever found in an uninjured sponge, in comparison with its diameter, was in a specimen where it extended entirely across the orifice excepting a narrow opening in the middle, measuring .05 in diameter. The tube on which this membrane grew was .65 in diameter and the membrane was situated about .25 from the termination. The next largest membrane was in the tube of the sponge (given in section in fig. 18, B: a life-sized figure of this membrane is given in fig. 19, B, and it may be contrasted with the more sunken membrane of its somewhat smaller neighbor at A. Just what the function of these membranes is it is difficult to say, unless it is to prevent the accumulation of sand. and other debris, in the central tubes. As confirming this hypothesis it may be remarked that the central tubes of all the Verongia that I have examined are remarkably free of foreign material of any kind.

When a cylinder becomes broken off anywhere a membrane forms at its broken termination, but it is questionable whether the sponge ever increases in length again. (See remarks in this under Variation of the Skeleton.)

In one specimen which has been attacked by a parasitical sponge, and its structure greatly disturbed thereby, a partition has grown up within the main tube, near the termination, supported by the horny skeleton, thus forming a kind of double tube, each division of which is provided with its own membrane. On the side of the cylinder not far from its termination are two oscules, each with a membrane that stretches nearly across it, while other oscules are forming about it. This seems to me a clear case of reversion toward some ancestral branching form, brought about by the disturbance produced by the parasitical intruder; but to this subject I shall refer again.

An extraordinary case of membrane formation may be seen in the young sponge given in fig. 20 where the terminal end is completely closed by a membrane (See ib., A, a), and the lower or basal extremity being broken, exposing the inner tube, a membrane is partly formed across the exposed portion, which, as the normal opening was closed, became the mouth. (See ib. B, b, being the supplementary closing membrane).

In two or three other instances where I have seen holes broken in a cylinder I have also found a membrane stretched partly across the tube above the injured portion. Unquestionably in this case, and also in the case of the young sponge cited above, an attempt has been made to repair the injury to the cylinder. This injury cannot be remedied by a new growth from the broken portion, for as I have demonstrated under the head of Skeleton no growth of either sarcode or of horny matter ever takes place from a broken surface. Hence it is that the membrane is first thrown across above the injured portion as a preliminary to the growth of the sarcode and accompanying skeleton, thus accomplishing a permanent repair of damages. The specimen in fig. 22, B, shows an example of where a permanent partition has been formed above a broken cylinder. In this case the cavity, d, has been filled with sand and the partition a, has been formed above it, completely across the tube. So solidly was this partition constructed that it formed a new base for the sponge and, as seen, a bud grew from above it.

I have found one other remarkable variation in the formation of this membrane in a tube, where, by some accident, the whole sponge was pressed flat when living, probably temporarily closing the terminal orifice of the central tube. Then there was a new orifice formed on one side; but the pressure afterwards being removed, and the original terminal orifice reopening, that in the side was closed by a membrane.

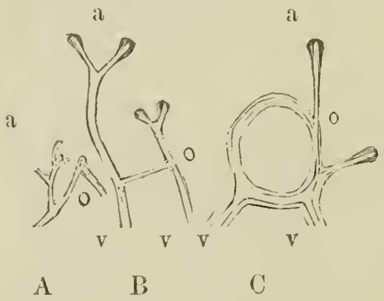
Sometimes, more especially in large single cylinders, the tendency to grow outward at the extremity is so great that the tube gradually widens, and becomes trumpet-shaped. Such cylinders are inclined to bend downward and I have found quite a number of these specimens among the sponges gathered at Inagua. These sponges being simple cylinders, with thin walls, have evidently thrown all of their vigor into an upward growth, but all stages of intergrades occur between this form and the types.

SKELETON.

The general color of the skeleton is amber, light when young, but darkening with age. The fibers are cylindrical, well rounded and seldom flattened even at the points of jointure. They are hollow and at the extreme tips of the new growths are composed of a single, soft membrane which is yellow in color and opaque. This soon becomes covered with a layer of pale, amber-colored, horn-like matter which is nearly transparent and successive layers of this horny matter are deposited; thus the older growths not only become larger in diameter but darker in color on account of the continuous thickening of the deposits (See figs. 23 and 25 where I have given an enlarged cut of the fiber, a being the new at A, C and B in fig. 23 and v the old: then compare with the old growth in fig. 24 C: in this the original hollow membrane may be seen through the transparent walls.

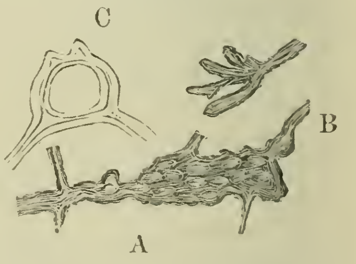
New twigs of the fiber arise from division at the extreme tips of the new growths (See fig. 25 C, a, and fig. 23 a.) The twigs thus formed although of an equal length at first, do not always remain so, for the onward growth of one may assume a different direction from that of the other, so that it may sooner come in contact with the tip of another tube and anastomose with it; thus forming a comparatively small mesh in the net-work of fiber while the other may grow to a greater length, and then anastomosing form a larger mesh. (See fig. 26

FIG. 23.



Illustrating the anastomosing and twig division of the fiber of V. fistularis. B, a division of twig. C, a, new twig before dividing; o, o, o, in all is the anastomosing point.

FIG. 24.



Illustrating arrested and abnormal growth of the fiber of V. fistularis. C, arrested growth. A, B, abnormal growth.

K and S, where I give a life-size section of the growing skeleton of V. fistularis, and the different sizes of the mesh of the net work may be seen) consequently this forms an irregular anastomosis.

As the direction assumed by a new twig is rarely the same as that taken by the one immediatedly behind it, sometimes the new twig comes in contact with the thick skin covering the outer surface of the sponge or with the lining membrane of the central tube: in either case the hollow at the tip of the growing fiber becomes closed and afterwards permanently sealed with horn. (For examples of these arrested growths see fig. 25, A and B, and fig. 26, A to J.)

Thus it is easy to distinguish between what is a continuous, or new growth of a twig, and an old, or arrested, growth. The growing twig being much more slender than the old growth, is destitude of horny matter at the extreme tip and above all the termination in the new twig remains constantly open, while it is closed in the old growth. Thus by simply observing the condition of the termination of the twigs we can ascertain whether a sponge is growing in any particular direction or not.

Of course as the skeleton is formed from the sarcode, or sponge flesh, this always grows in advance of the horny fiber. This fleshy matter is rather more dense around new fiber, especially about the tips of the growing twigs. When division of the twig is about to take place this thicker sarcode becomes more bulbose about the extreme tip of the growing twig than at other times, and in this bulb the division of the twig occurs. (See fig. 25, C, a, where there is a divided twig and compare with b in which division is not taking place.)

I may here say, in passing, that the best way to examine the skeleton for a new growth is in an alcoholic specimen. The flesh may be easily removed, bit by bit, with a needle, taking care not to break the delicate terminal fibers. But although it is quite easy to satisfy one's self as to the method of growth, it is not always easy to find a twig in the act of dividing. I have, however, found several, and have a number of times traced a complete series from the very earliest division to the point of anastomosis or to arrested growths.

The growth at the terminal portion of the tube is most rapid and of course upward and slightly outward, but never inward, and branches of the fiber continue to grow, sending out many twigs before any anastomosis takes place. Or in other words that portion of the cylinder which is the most advanced produces branching fibers which push upwards without anastomosis, fibers which send out lateral branches are the ones which anastomose. Anastomosis appears to take place by the tip of one growing twig coming in contact with the side of another growing twig. This combination must take place near enough to the termination to have the inner membrane naked or not covered even with a single layer of horny matter, then a perfect anastomosis takes place; that is, the tip of the anastomosing fiber absorbs that portion of the other's tubular membrane with which it comes in contact; thus the hollow becomes continuous from one fiber to another. The growth of the twig coming in contact is at once checked and horny matter is deposited over the place of jointure. (See fig. 23 where I give three examples of the anastomosis of growing twigs, at A, B, and C, o, being the point of jointure, and as will be seen this is not always at the same angle, that at B being at right angles, that at C being obliquely downward; while at A it is evident that the tips of two twigs came directly in contact, and upon anastomosing the growth of both was checked.)

It is absolutely certain according to my most carefully made and often repeated observations that no buds ever start from the side of a twig or branch. Hence the interior of the skeleton of V. fistularis presents a very finished appearance there being no protuding twigs or arrested growths which have not anastomosed. (See fig. 26, K, where I have given a portion of the interior of the skeleton, life size. This is not so, however, where the twigs have come in contact with the skin of the outer surface, or with the membrane lining the central tube, for here as I have previously remarked, we find many short, protruding twigs.

As both sarcode and skeleton become arrested as soon as they become covered with the lining membrane of the central tube, it will at once be seen that there can be no increase of growth inward after this membrane is grown; and that the form of the sponge is determined by it. The tendency of the growth of the sponge is thus upward, and although, somewhat singularly, the upward growth sometimes considerably precedes the thickened lining membrane (See fig. 18, A) the inclination of growth is very rarely, or never, inward. For proof of the assertion that the lining membrane arrests any inward growth see fig. 18, A and B, a, a, a, a, being the lining membrane of the tube, also in the young specimen, fig. 20, B, where the tendency of growth is outward so as to gradually form a wider tube.

Returning again to arrested growths of the twigs of the skeleton, we find that those on the outer surface of the sponge differ, as a rule, from those on the inner. The differences are slight but very constant. Externally the growth appears to be checked gradually as it comes in contact with the the outer skin, and as a consequence the arrested growths are pointed. (See fig. 26, C and D ; the two twigs in the latter named being normal, that at C having become arrested immediately after division had taken place. In some instances after the normal growth of twigs has become arrested on the external surface, and the sponge has become finished, in that direction, a kind of secondary growth appears that is quite independent of the hollow structures of the fiber. These form minute, rather opaque, often branching twigs, having their origin directly on the end of the arrested growths. Examples of these may be seen in fig. 26, A and B.

Internally, or against the lining membrane of the central tube, we find the growth much more suddenly arrested. Hence the twigs present a more truncated appearance. (See fig. 26, F, G, and J, and fig. 25, A and B). In some cases the arrested twigs of the interior present a cup-like depression at the extremity. (See fig. 26, H and the one directly above it.) In these twigs the hollow membrane is sealed but is covered with only a thin layer of horny matter. This is evidently the consequence of the twig having passed a little beyond the sarcode into the lining membrance of the tube. Or rather this is the condition under which such twigs are found, but it is quite probable that the lining membrane has absorbed a portion of the sarcode and grown around the twigs before the usual quantity of horny matter was deposited on their extremities.

VARIATIONS IN SKELETON GROWTH.

I have said that new fibers usually anastomose with new growths, and this is true where an unbroken internal membrane occurs, thus this is the normal method of growth, but where new and growing fiber comes in contact with an old growth a kind of anastomosis also takes places. In this case the growing tip of the new twig comes in contact with the horny side of the old growth and is soldered there by an accumulation of additional horny matter, secreted quite likely by both the old and the new sarcode. But in all such anastomosis there is no connection between the internal hollow membrane of the fiber of one growth with that of the other. That is the new growth does not penetrate into the horny covering of the old growth as it does into the membrane of the new.

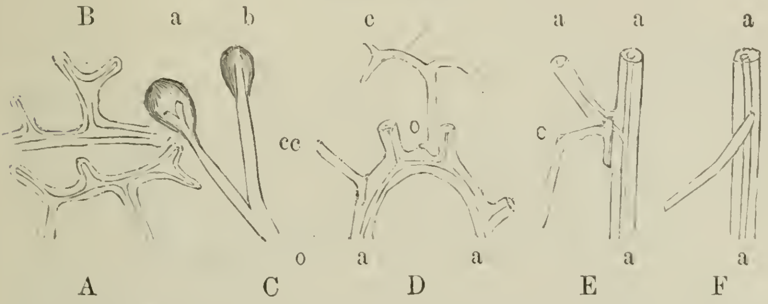
Another peculiar feature of this method of anastomosis is that when the new growth comes in contact with the old, the new twig, no matter at what angle it comes against the horny side of the old growth usually continues to grow for a short distance, thus ensuing a greater surface of attachment. But as I have never succeeded in finding a case where this growth continued entirely beyond the point of jointure, it is probable that the horny matter, secreted by the sarcode upon both the old branch and new twig, especially the former, soon closed the open tip of the new twig, thus preventing further growth.

In fig. 25, at D, E, and F, I give four methods of this kind of anastomosis when new twigs have come in contact with old (in all of these figures a is the old growth and c the new) all at different angles. In that at D, c, c, the new growth came upon the old branch obliquely, grew slightly backward but further forward, then became arrested. The new twig above this at c, came upon the branch directly at right angles and passed partly around it. The twig at E after bending at o, reached the branch at a slightly oblique angle, and on account of another branch being in the way, after progressing forward a little way, its growth was forced abruptly backward. At F the twig has come in contact with the branch along its side not directly against it, as in the other instances; yet even in this case it did not progress far. All of these examples of anastomosis occurred within a short distance of one another, but there were hundreds of similar cases in this same sponge.

Upon the most careful examination of this and other sponges of this species where a new growth has come in contact with an old one, I have failed to detect the slightest sign of any revivification of the old skeleton. This has led me to the conclusion that after the horny matter has been deposited over any portion of the fiber, no outward growth of buds nor twigs can take place. This conclusion is borne out by the fact, previously mentioned, that two old sponges coming in contact do not anastomose along their sides.

It is most evident that a new growth can take place only where the inner membrane of the fibre still remains in direct contact with the sarcode. It is also evident, as will be seen, that the membrane itself, is capable of producing new growths by division only at its extreme tip, and always before it has become covered with horny matter. After this horny material is deposited the membrane appears to become dead. This I have proved conclusively by examining several tube sponges which have been broken, while living in the water, within an inch or two of the base. These bases were living, had deposited sarcode over the broken surface, (thus completely covering the ends of the severed portion of the fibers), and had in two or three cases even constructed new closing membranes at the entrance of the central tube, but upon carefully measuring one of these broken cylinders and examining others, I find that there is absolutely no new growth from the broken portion of the skeleton; nor are the tubes of the broken ends of the fibres even closed with horny matter. Of course, I have no means of judging when the sponges were broken, excepting from their appearance. These specimens were collected at Allen's Harbor, in about thirty feet of water, in a place that was quite well protected from heavyseas during ordinary weather. While it is of course possible

FIG. 25.

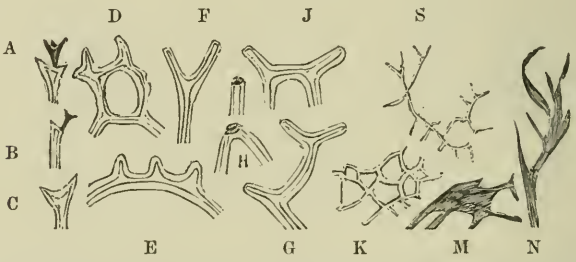


Fiber of the Orange Tube Sponge A and B, arrested twigs from the inner tube. C, new growths. D, E, and F, new growth anastomosing against old; a, old growth, o, new.

that some large marine animal, like a shark or turtle, might have broken these sponges, it is more probable that they were injured during some hurricane. Now these sponges were collected in May, 1893, and the last hurricane that visited the Bahamas occurred in August, 1892, and this was not specially severe. If they were broken by the waves of that gale they had had eight months in which to repair damages, and, they may have been broken during a previous season. Why the new sarcode deposited over the broken ends of the cylinder did not produce a new growth of fiber, independent of the old growth, as we have seen that it does when a new partition is formed across the central tube, and what the ultimate fate of these broken cylinders is, it is difficult to state. As I have never found any buds starting from their base, nor any larger growth about them, it is probable that these broken sponges being unable to entirely overcome the shock which they have sustained, are leading a kind of life in death existence, and that, after lingering for a comparatively short time, die.

We have seen that abnormal conditions of growth appear to occur in the tube sponge when it is attacked by parasitical sponges. I cut off a portion of the specimen of which I have spoken on page 61 as having been attacked by a parasitical sponge of the spiculigneous group (the Purple Sponge, Pachychalina rubens), where the intruding species had come in contact with the skeleton, and upon examining it, found that many of the fibers are apparently in a diseased condition and present abnormal growths. They are enlarged in places by a whitish accumulation of a substance which appears to arise directly from the horny covering of the fiber and to form a part of it. Such examples are given in fig. 24, A and B. There is also a great tendency to produce abortive twigs, often in terminal tufts.

Fig. 26.



Illustrating the skeleton of V. fistularis. A, B, arrested twigs with secondary growths, C, twig arrested just after dividing. D, arrested twigs from external surface. F, G, J, same from surface of central tube. H, and above, the same with cuplike depressions. K and S, portion of skeleton enlarged four times. M and N, flattened fibers from filamentos growth. E, arrested twig which came in contact with a hard surface.

We find this tendency to produce abortive twigs in the protuberances on the sides of aged and much roughened sponges. In these we also find a kind of secondary growth in the form of fine new twigs, which appear to be filling the cavities between the projections, thus thickening the walls of the sponges.

It now remains only to examine the fibers of the elongated filamentos growths of which I have spoken and of which I give a cut in fig. 21, B, page 65. Here we find that the growth is inclined to be upward rather than lateral, that the meshes of the skeleton are elongated, and that the fibers are greatly flattened. These fibers do not present a healthy appearance, nor are they thickly covered with horny matter. I give an example of these flattened and antler-like fibers in fig. 26, M and N. These are from the long filamentos projection of which I give a cut in fig. 21, B. [NOTE. All of the figures of fibers given are enlarged about ten diamenters excepting when they are given as being otherwise.]

It is instructive to note that when growing twigs come in contact with the rocky surface upon which the sponge grows that they become arrested suddenly in a similar manner as when they come in contact with the lining membrane of the central tube. (See fig. 26, E, where I give a cut of three of these arrested growths.)

HABITS AND DISTRIBUTION.

The first time I ever saw the orange tube sponge outside of a museum was on the island of Inagua. Just to the north of Mathewstown are high cliffs which extend for about a mile along the water, terminating in a sandy beach to the northward. I visited this place in February, 1887, and during the preceding September a hurricane had swept over Inagua. The waves caused by this tempest had separated a vast number of sponges from the neighboring reef and lagoon. The sea must have been very high for it had deposited thousands of sponges in one great wind-row on the top of the cliffs near the beach. Here I found hundreds of tube sponges, nearly all of them fully marcerated. Few of them were absolutely perfect; being mainly detached tubes, but I learned considerable about this species and brought away two or three hundred selected specimens with me.

In all of my explorations among the Bahamas and Florida keys, I have found the tube sponge living in one section only, although I have constantly searched for it. When in company with my friends, Messrs. Curtis and Thorndike, I visited Highburn Key in April, 1893, I found the first specimens I ever saw growing on small detached reefs in the little harbor to the south of the key. The reefs on which they grew were well out on the edge of the channel that divides Highburn from a neighboring key and the sponges were in from twenty-five to thirty feet of water.

They were usually attached to dead coral and grew upright among hundreds of specimens of other sponges, but were always conspicuous when seen through the beautifully transparent water on account of their brilliant orange yellow color. They usually prefer rocks slightly elevated above the bottom, but in some cases they grew directly on the bottom where they were surrounded by sand. When brought to the surface and exposed to the air they almost immediately began to blacken, beginning to change color, first where they were bruised even ever so slightly, then the dark hue spread rapidly over the entire sponge. When handled, the mucous-like substance which exuded from them also oxidized and stained the hands black.

Upon the closest examination, I could not perceive the slightest shrinking, nor any contraction of the sarcode, nor any changes whatever in the diameter of the orifice in the middle of the closing membrane of the central tube.

We also procured a quantity of these sponges at Allen's Harbor, about three miles north of Highburn Key, all growing in comparatively sheltered situations as at Highburn Key, that is never directly in swift tide ways, but always in moderately strong currents, where they could receive a constant supply of fresh sea water.

When first taken from the water the Orange Tube Sponges are quite firm, but as soon as they are dead they soften considerably, and in order to dry them in a natural form they must be laid perfectly flat and turned frequently. Unless the cylinders are very short they cannot be dried in an upright position, as they are liable to bend.

This species has a peculiarly sweetish odor, not as disagreeable as in many other sponges and this is retained in the dried specimens to a great degree : this odor is particularly noticeable upon wetting a dried specimen. When thoroughly soaked the dried sponge returns in a great measure to its former elasticity and becomes somewhat smooth, and then the incurrent orifices can usually be found.

Judging from my experience with this sponge, it is extremely local in distribution as it requires peculiar conditions for growth. The depth of water must be sufficient to protect the cylinders from any great wave agitation, for they break quite easily, as I have myself seen when gathering them with a sponge hook, and the large number of detached cylinders which I found on the cliff at Inagua also shows that they are easily broken off by any unusual disturbance of the water in which they live. It is evident that the zone inhabited by this sponge is in between twenty-five and thirty feet of water, and as this is not below the action of wave agitation during ordinary tempests, in order to exist unbroken the Orange Tube Sponge must seek the protection of either land locked or reef locked harbors, in which the water is of the proper depth, and through which moderately flowing currents constantly sweep.

Again, it is worthy of note in this connection, that two species of sponges, which are particularly parasitic in their habits, are seldom found in the haunts of this Verongia. These are the Purple and the Cord sponges, and probably they are absent because the locality is in some way unfavorable to their growth: at all events, as they are detrimental to the Orange Tube Sponge, as already shown, we should expect it to grow more readily in a locality not inhabited by them. As all these conditions conducive to its growth are not often combined in one locality it is quite easy to account for the comparatively local distribution of this sponge.

As has been remarked, it is usual for the Orange Tube Sponge t adhere to dead coral, or to rocks, but I have one specimen, consisting of a double cylinder and two single tubes, that is adhering to a partly dead sea-fan one branch of which is projecting above the sponge. This branch is incrusted by a parasitical spiculiginous sponge which is evidently a recent interloper, as it has not yet affected the surface of the Verongia in any noticeable way.

COMPARISONS WITH ALLIED SPECIES.

One of the nearest allies of V. fistularis is the Rigid Tube Sponge, Verongia rigida, but this last is much smaller in height and much less in diameter than in V. fistularis. I have never seen this species living but Duch. et Mich. who are perfectly familiar with the species say that it is about as large as the finger, even in specimens that have attained a height of three or four inches, whereas in V. fistularis a cylinder of that height would be at least three times as large. Both V. fistularis and V. regida are orange yellow in color when living, but the first inhabits deep water, whereas the other lives in shallow water.

Another allied species is the Black Tube Sponge, Verongia sebae, but this is black when living.

Still a third allied species is the Brown Tube Sponge, Verongia rupicola, which is very rough externally and brown when living.

For further comparisons with these and other sponges see remarks under head of these species, also see remarks under head of doubtful species.

From all other sponges of this genus, Verongia fistularis differs in being tubular.

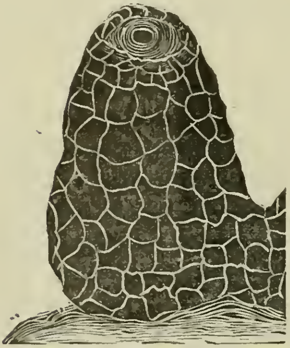
There is a superficial resemblance between the Orange Tube Sponge and some members of the genus Stelospongos, notably with S.

maynardi Hyatt, S. cribriformis Hyatt, and S. fenestriata, Duch. et Mich., but all of these, although somewhat tubular in form (See fig. 27, where I give a reduced cut of Stelospongos cribriformis), are very different in the structure of the skeleton, which is very loose and net-like, there being numerous, rather regular, honeycomb-like cells which penetrate to the central tube without being interrupted by any cross fibers, much as in the Giant Cup sponge, Aplysina gigantea (See fig. 16, page 57, and fig. 28; also fig. 27).

HISTORY.

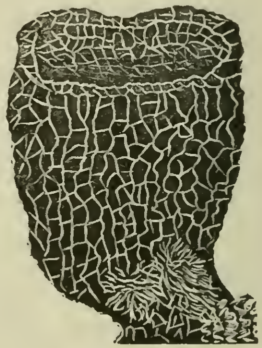
For the specific name fistularis we have to go back to Linnaeus' "Systema Naturae," XII ed., 1767. But unfortunately his description, given in half a dozen lines of Latin, might be applied to any tubular sponge, and above all he gives the habitat of his species as being in the Indian Ocean.

FIG. 27.



Net Sponge, Stelospongos cribriformis, reduced size. Nassau Harbor, April, 1893.

FIG. 28.



Giant Cup Sponge, Aplysina gigantea; reduced size; Allen's Harbor, May, 1893.

It remained for Esper, in 1794, to describe the species so that it can be recognized, and his figures are also clearly of this species.

Bowerbank, in 1845, in using the species for his type of the genus Verongia, examined alcoholic specimens, and gives us some valuable information concerning it.

Duch. et Mich. in 1864 do not appear to be at all familiar with the species, having seen none living, and thus give little or nothing new concerning it.

Hyatt, in 1875, gives us some valuable notes upon the skeleton but, through unfamiliarity with the living sponge, considers two other very distinct species as being simply forms of this, namely, Verongia flava and V. insularis; both of these species have been described by Duch. et Mich., and the former figured by them.

Lindenfeld, in 1889, also through an unfamiliarity with the living sponge, gives one form of individual variation only as V. fistularis, one similar to that which I have given on Plate IV, a much roughened form having the elongated upward-turned projections.

DOUBTFUL SPECIES.

Sponges are so different to describe, and there is such a wide individual variation among them, that it is not always easy for an author to designate his species in such a manner that they can be recognized. This is especially true if one is not familiar with a given species in all its phrases of appearance, living and dead. So much confusion has already been caused by including as synonyms what are perfectly distinct species, through failing to comprehend an author's meaning, that I have decided not to give any form described by another author as a positive synonym, without either having seen that author's type, or having collected similar specimens in the identical locality from which his type came. But as, in my studies of Verongia fistularis, I have been enabled, through fortunate circumstances, to cover considerable ground with more or less care, I feel in a position to express an opinion regarding three forms of Verongia, described by others, which I cannot avoid regarding as somewhat doubtful.

First we will take the Luffaria nuciformis of Duch. et Mich., described by them in Spong. de la Mer Cairib. (page 60, Plate XI, fig. 2). Upon reading the description of this sponge, given by these authors we find that they have never seen it living, and that their entire account was based upon skeletons, which were thrown upon the shores of St. Thomas, during a tempest. There is nothing in the oval, double form, figured by them, that cannot be matched by dozens of examples of specimens of undoubted Verongia fistularis, found by me at Inagua, nor does their description give any characters by which their species can be separated from the Orange Tube Sponge. Then, above all, they were unfamiliar with their supposed species when it was living, nor were they familiar, as they show by their published account, with the true V. fistularis, having seen but few skeletons and none of the living sponges. But in spite of this array of facts against admitting this form to a specific rank, I hesitate to condemn it as a synonym, not only because I have not seen their type, nor had specimens of tubular sponges from St. Thomas, but more especially because I have now in my possession a single sponge taken at Port Antonio, Jamaica, and kindly presented to me by my friend, Geo. F. Curtis' that corresponds in form to the V. nuciformis of Duch. et Mich. This would not, of course, be sufficient to make the specimen worthy of any consideration, but it also appears to present some peculiarities of skeleton formation, which causes me to keep the whole matter in abeyance, until I can examine other sponges of this genus from Port Antonio.

We next come to Aplysina archeri of Higgins, as redescribed by Lindenfeld (who has seen the type), and figured by him in Monog. of the Horny Sponges (p. 221). The smooth, greatly elongated, rather trumpet-shaped sponge, here given, appears so me to exhibit merely the extreme of the range of individual variation, already pointed out by me under Variation of form of Verongia fistularis.

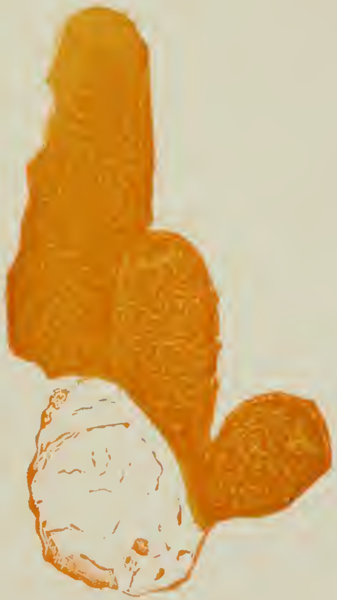
Aplysina spengelii of Lindenfeld is also described and figured in his monograph (p. 221). This appears to me to be another smooth form of V. fistularis, with the walls thin, and with the tube of uniform diameter for its entire length, all characters of no specific value, as all fall within the range of usual individual variation which, I have shown, occurs in the Orange Tube Sponge. While I feel quite sure that had Dr. Lindenfeld had the opportunity of examining the specimens which I have seen under the circumstances in which I have found them, he would never have given the two species, cited above, specific rank, I hesitate to give a verdict entirely against them, without having examined the types.

PARASITES OF VERONGIA FISTULARIS.

One of the most usual internal parasites of the Orange Tube Sponge is a small worm, about .10 in length, which lies encysted in the sarcode, among the tubes of the water system (See fig. 14, D, o, where I give an example of this species). So abundant are these intruders, that it is almost impossible to cut a sponge of these species in any direction without encountering one of them. More rarely another species of marine worm is found inhabiting the water tubes, where a small, short-footed crustacean also occurs.

On the outer portion of the sponge, especially upon old sponges having roughened protuberances, there is found a small species of algae, having numerous branches. Bits of shell and sand are

PLATE V.



Verongia fistularis,
One half life size. Smooth form, color of living specimen.
Allen's Harbor, April, 1893.

frequently found imbedded in the sarcode but whenever there is an accumulation of this sand at any point it becomes encysted in a body, and the loose pieces found unencysted in the sarcode may be thus gathered in course of time. In fig. 14, D, at v, v, I give an example of these sand cysts. Also in fig. 15, B, where either the course of a water tube was interrupted by a large mass of sand, or it had become partly absorbed during the progress of the accumulation of the sand· the latter hypothesis being the most probable.

CONCLUSIONS AND SUMMARY.

The Orange Tube Sponge has an exceedingly wide individual variation, hence we may judge that it is of comparatively recent origin, and that it has either given rise to closely allied species, or that it is likely so to do. All of these new species will retain the most prominent characters of their originator, thus differing from it in minor particulars only. There will also be a great tendency in the allied species to exhibit reversions, in some of their characters, toward salient points of individual prominence in V. fistularis. A sufficient number of correlative, or other, characters, will, however always remain unchanged, holding the new forms distinct from the parent stock.

A prominent character in V.fistularis is the great central tube, which feature, is, however, shared in common with other sponges often of widely different groups, Aplysina, Stelospongos, and in some members of the genus Spongia, are examples among the horny sponges, while Tuba and others occur among the spiculiginous sponges. The closing membrane of this tube, so characteristic of the genus Verongia, is found in two other genera only that I have examined, namely: Stelospongos, and in some of the species of Spongia (S. discus being one).

We find that the tendency of the Orange Tube Sponge is to form single cylinders, and these often attain a considerable height, but in these cases the vigor of the sponge appears to be thrown into this special growth, at the expense of the thickness ofthe walls, and consequently of lateral protuberances of any kind. On the other hand, as the cylinders belonging to a single colony increase in numbers they grow shorter, but have thick walls.

Increase of cylinders takes place (normally) by buds which appear at the base of the original cylinder or cylinders, for two or more of these tubes may originate at the same time. Buds are quite likely to appear when any disturbance takes place in the growth of the original sponge; for example, the presence of any parasitical sponge has a tendency to cause a disturbance in the system that results in abnormal budding. The merging of two cylinders into one also produces the same results. And cylinders in which breaches in, or near, the base occur, above which a partition has been formed, are apt to throw out buds, but the buds always appear above the partition.

Cylinders broken completely off, do not, however, send out buds from these bases, nor are they capable of repairing the damage that they have sustained, by reproducing the lost parts, and, as seen, these sponges are not even able to repair holes broken in the cylinders, but curtail their length, by forming a partition, which becomes a new base.

The closing membrane, of the central tube, whatever its function may be, is quite variable in size, and somewhat in its relative position at the mouth of the tube. This points to the conclusion that this membrane must, through the constantly upward growth of the sponges, be absorbed and reproduced many times in cylinders of any great length.

The water system is quite simple, constant open incurrent tubes, admitting water to a series of cilia cells, that often communicate with each other, and some of which, but not all, are provided with excurrent openings, which emerge in the great central tube, and are guarded from the influx of water, that fills this large tube, by a kind of sphincter valve. Formation of the fiber of the skeleton is by division of the hollow lining membrane, when this is in progress of formation, in the growing sarcode. After this membrane becomes covered with a deposit of amber-colored horny matter, or after the open tip of any particular twig has become sealed with it, the growth of that twig is terminated, and can never be renewed from within.

Anastomosis, although usually taking place at the tips of the growing twigs, or very near them, may take place by a new twig coming in contact with the walls of an old branch or twig. In both cases, the growth of the anastomosing twig is checked, but in the first case the hollow between the two twigs, in joining, is continuous, whereas, in the second case, there is no continuous hollow between the new twig and the older horn-covered growth.

Attacks of parasitical sponges produce unhealthy and abnormal growths of the skeleton in Verongia fistularis. We have seen that Orange Tube Sponges with many cylinders are comparatively rare.

and when such specimens do occur they never grow to any great height, thus an increase of cylinders means a corresponding decrease of height. Now this would appear to indicate an inclination to revert toward some ancestral species, having many short cylinders, or to show a tendency to form a new species, having similar characters. I am, however, inclined to think the former hypothesis most correct, for reasons which I shall give under the head of Conclusions in Verongia rigida.

We also find a probable tendency to revert toward some ancestral species in the production of protuberances of various forms, but as the skeleton of these excresences presents an abnormal and unhealthy appearance, which shows that the growth of these forms is very limited, we can only consider them as falling within the range of individual variation.

A careful consideration of the foregoing array of facts will certainly lead us to the irresistible conclusion that, whether or not we regard each cilia cell, or a number of these cells, as constituting a separate individual, equivalent, for example, to a coral polyp, the water system and its accompanying cilia cells, at least combine together in emergencies, and with common sympathies and common energies, act as the organisms of a single individual throughout the whole sponge.

SMALL TUBE SPONGE.

Verongia rigida.

Plate IX.

Spongia rigida Esper, Pflanz., tab. XXVII, figs. 1 and 2.
Duch. et Mich. Spong. Mer Caraib., page 61, Plate XII, fig. 1.

DESCRIPTION.

Sp. Ch. Small sponges, consisting of a number of cylinders, which are usually free at the summit. Externally the surface is roughened by prominent ridges separated from one another by depressions, these ridges being longitudinal, but with some cross bars, thus forming a kind of checker work. Living, this sponge is yellowish orange; when dry it is black. The skeleton is amber-colored. It is very common at St. Thomas, when it occurs abundantly at the mouth of the port and is very easy to procure, as it occurs in shallow water.

DIMENSIONS.

Height of cylinders, from 1.00 to 3.00. Diameter of cylinders, .75. Diameter of tube, .30.

OBSERVATIONS.

Although I have never seen a specimen of this sponge living. I have, contrary to the opinions of most recent authors, considered the Spongia rigida of Esper as a distinct species. My reasons for so doing are based wholly upon the observations of Duch. et. Mich. (who were familiar with the species living) and are as follows :

First, the cylinders are many.

Second, they are small in diameter in comparison to their height. (less than an inch in a cylinder three inches high) which is much smaller than in any specimen of V. fistularis that I ever saw.

Third, this sponge lives in shallow water. Duch. et Mich. do not state the exact depth, but they do say that it is found in water of little depth, at the mouth of the port of St. Thomas, and that it is easy to procure. whereas, speaking of V. fistularis, they state, that it lives at great depths and is only thrown up on the shores during tempests.

We have seen that many cylinders in V. fistularis are exceptions to the usual rule and must be regarded as the extremes of individual variations, either in the direction of a presagement toward the formation of a new species; or as a reversion toward some ancestral stock. As previously recorded, I am inclined to think that this latter hypothesis is the more correct, and that this ancestor is the species which we have under consideration. Of course, in making this provisional statement I am taking it for granted that the deep water forms of sponges are derived from shallow water species, or in other words, that all sponges originated in shallow water. This opinion is based upon the fact that no sponge appears to live in very deep water, the inclination being to inhabit comparatively shallow water.

I have reproduced as nearly as possible, on Plate IX, the drawing of the living specimen of Verongia rigida given by Duch. et Mich. on Plate XII of their work. The cylinder on the right is evidently represented as being cut through, longitudinally. hence a portion only of this sponge is figured, and we may safely judge that the specimen from which they were drawn was a cluster of tubes with a number of short buds about its base. the buds being uncolored in the plate.

SUMMARY.

In the Small Tube Sponge we have a species living in shallow water, composed of several clustered cylinders, that are small in comparison to their height, and which are tubular from base to summit.

COMPARISONS WITH ALLIED SPECIES.

The nearest allied species to the Small Tube Sponge is Verongia fistularis, from which it differs in having more cylinders, which are smaller in diameter in proportion to their height. It also inhabits shallow water. From other distinctly tubular species of Verongia it differs in being orange yellow.

BLACK TUBE SPONGE.

Verongia sebae.

Luffaria sebae Duch. et Mich., Spong. Mer Cairib., p. 59.

DESCRIPTION.

Sp. Ch. Rather small sponges, consisting of one or two cylinders, much roughened on the outer surface by protuberances which are generally longitudinal. The cylinders are provided with orifices which measure about .50 in diameter. Living, the species is black and is the same color when dried. The skeleton is yellowish. Habitat, St. Thomas, Tortolas, Vircques.

OBSERVATIONS.

I have included this species wholly upon the authority of Duch. et Mich. Although they do not give the size of the sponge, we can judge that it is small by the size of the orifice (four or five lines) but what is most remarkable is the color, which is given as being black when living, thus differing from any other sponge of the genus with which I am familiar.

BROWN TUBE SPONGE.

Verongia rupicola.

Luffaria rupicola Duch. et. Mich.. Spong. Mer Caraib. p. 60.

DESCRIPTION.

Sp. Ch. Medium sized sponges, consisting of two or three thick-walled cylinders, much roughened on the exterior surface by bosses and irregular mammiform protuberances. Brown, when living, but becoming black when dry. It differs from the preceding species in having the peculiar rounded protuberances and very thick walls. Habitat, St. Thomas.

OBSERVATIONS.

This species is also given upon the authority of Duch. et Mich., and appears to be quite remarkable, not only in being brown in color, but in having the singular protuberances.

In recognizing the specific rank of the last two species I have been obliged to depend wholly upon the observations of Duch. et Mich. But as I have found that the descriptions of species with which we are mutually familiar are always reliable, I see no reason to doubt their statements in these cases. I also know that many sponges are exceedingly local in their distribution and that, as I shall show, this is particularly true of some members of the genus Verongia; therefore, it is reasonable to suppose that the cause of our not finding these species in collections is that no one has recently gone over the localities where Duch. et Mich. obtained their types.

DWARF TUBE SPONGE.

Verongia applicata.

Luffaria applicata Duch. et Mich., Spong. Mer Caraib.

DESCRIPTION.

Sp. ch. Sponges encrusting bodies in the sea. This encrusting portion is from .50 to 1.00 thick and from it rises many short cylinders not over 1.00 high, and about .50 in diameter, each of which is provided with a central tube or oscule. The skeleton is rather loosely constructed but resembles that of other members of the genus. Habitat, St. Thomas, also Inagua.

OBSERVATIONS.

Of this remarkable sponge I obtained a single specimen at Inagua, which has been mislaid and cannot be found, thus my description is founded mainly upon the account of Duch. et Mich., aided by my recollection of this specimen. Most unfortunately we know nothing of the living sponge, nor anything of its habits, but I am confident that it will be found to inhabit shallow water.

FILAMENTOS SPONGE.

Verongia insularis.

Plates X and XI. Figs. 29, 30 and 31.

Luffaria insularis Duch. et Mich., Spong. Mer Cairib. page 61.

Verongia fistularis Hyatt, Review N. A. Porif., Part I, p. 102. (in part) 1875.

DESCRIPTION.

SP. CH. Small sponges, composed of a number of flattened tubes, connected together at their sides, but free at their summits. Outer surface very smooth in life.

STRUCTURE. In life this species is rather fleshy and very soft, but when dry becomes quite rigid. The water system is as simple as in V. fistularis, but differs somewhat. The incurrent tubes are arranged in groups, where they are very numerous (See fig. 31, a), usually on the sides of the sponge, quite low down on the cylinder. The orifices are very minute, and open into a similar tube as in V. fistularis. The cilia cells are very small, and communicate with one another through narrow tubes. These open into excurrent orifices, either singly or through some common orifice, as in V. fistularis. The excurrent orifices are therefore not numerous (See fig. 31, a, being the very numerous incurrent orifices, b, the few excurrent orifices, and c, the cilia cells and accompanying lateral tubes.

The central tube of each cylinder is provided with a closing membrane (See fig. 29, B, T), as in V. fistularis, but the great tube in itself differs considerably, for instead of ending abruptly at its base, as in V. fistularis, it continũes in sevēral ramifying, constantly narrowing tubes, and several of these smaller tubes also open along the sides of the central tube (See fig. 29, B, B, and to the left of A). All of these continuations of the common larger tube are also cloacal tubes, and are provided at intervals with excurrent orifices. The position of some of these excurrent orifices in the central tube may be seen at B, A, fig. 29, showing that they are not very near the mouth of the tube.

The membrane lining the central tube is thin and somewhat delicate, and terminates in a closing membrane, that gradually becomes thick at its margin.

FILAMEMTS. These arise on one side of the tubes at their termination, are of varying length and thickness, and are sometimes provided with an oscule at their summits. See Plate X where in the type the two truncated elevations in the center are filaments and there is another on the left.

COLOR. Living, orange yellow, quickly changing to jet black, upon being exposed to the air, and this color is retained when the sponge is quickly dried. In alcohol the sponge is dull black, with the interior grayish yellow.

DIMENSIONS.

Length of type, 3.00; width, 4.00; thickness, .50; depth of largest tube, 1.25; diameter of tube, .30; length of filament, .75; diameter, .30. Longest sponge, 5.00, widest, 5.00; thickest, 1.00; deepest tube, 1.50, longest filament, 4.00.

BUD PROPAGATION.

Budding for the formation of new cylinders takes place in three ways; from the base, from the sides of the cylinders (rarely), and from the termination of the filaments. The filaments appear to grow upward, as thin processes, originating always near the termination of an old cylinder from which these filaments are starting. The buds, basal and lateral oscules, appear to originate much as do the buds in V. fistularis.

BUD VARIATION.

The normal filament is usually short: that is it generally thickens and produces an oscule at its termination after growing about an inch in length, and seldom divides. In some cases, however, the filaments do divide, then they appear never to produce oscules, but keep on growing to a great length. (On Plate XI I have given a figure of a singular specimen of this kind, and, as seen, the filaments have grown into slender divided projections that are much longer than the sponge itself. At one point (A in the plate) two of these filaments have come in contact and anastomosed: but of this I shall speak later.

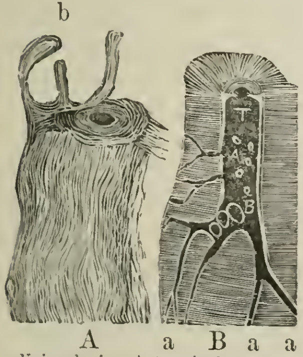
VARIATION IN FORM.

Aside from the variation already given in the elongation of the filaments, variation in form from the type is not great. There is a tendency to form a double row of tubes throughout the length of the sponge in some specimens, but I have never seen any rounded clusters, the inclination of growth of new cylinders appears to be from the outside of the outermost of the older growths, thus a flattened laterally-elongated sponge is produced.

SKELETON.

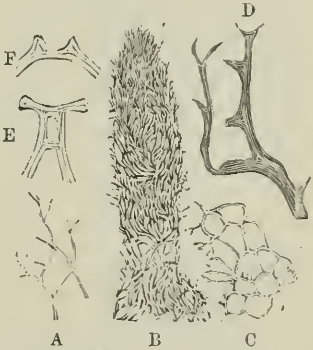
The color of the skeleton is light amber, and the fibers are much more delicate in structure than are those of V. fistularis, consequently the whole structure is less dense. The meshes are also elongated, longitudinally, that is, in the direction of the length of the tubes and filaments. (See fig. 21, A, and fig. 30, A, B, and C.) Production of new twigs is by division, while there are arrested growths as in V. fistularis, and from the same causes as I have there given, (See fig. 30, A, where I give a new growth, much enlarged, also E and F, where I show arrested growths). In the elongated filaments which I have judged will never produce oscules, I find that there is the same flattened antler-like growth that I found in the abortive filamentos processes of V. fistularis. As I have never seen an undoubted instance where a new growth has anastomosed with a old, I cannot state whether this is accomplished as in V. fistularis, or not, but see no reason why it should not be.

FIG. 29.



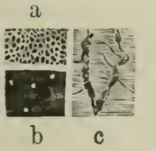
V. insularis. A, terminal portion of cylinder. b, filaments. B, section of same. A, excurrent orifices, a, a, a, B, branches of tube, T, central tube and membrane, Both enlarged four times.

FIG. 30.



Skeleton of V. insularis. A, C, portion of the skeleton enlarged four times. B, filament enlarged D, antler-like growth of filament. E, F, arrested growths.

FIG. 31.



Water system, V, insularis. a, incurrent orifices, b, excurrent, c, cilia cells.

cylinders in V. fistularis, but now as a useless reversion character. (See fig. 13, page 48.)

NOTES ON WEST INDIAN BIRDS.

The following article is a continuation of a series began in these Contributions, Vol. 1, page 171.

LARGE-BILLED VIREO.

Vireo crassirostis.

Plate XII, and fig. 31.

Vireo crassirostris Bryant; Proceedings Boston Soc. Nat. His., Vol. VII, 1859, p. 112.

DESCRIPTION.

Sp. Ch. Size, somewhat larger than that of the White-eyed Vireo, Vireo noveboracensis, with the bill proportionately larger; in color, grayer above, and uniformly washed with yellowish below.

The bill is quite long and thick, being as high as it is wide; the upper mandible is well curved at the tip and quite deeply notched.

The first primary, (spurious quill) is quite long, exceeding in length one half the second. The second is equal to the ninth, and the fifth is longest, but the third and fourth are but little shorter. The feet are large.

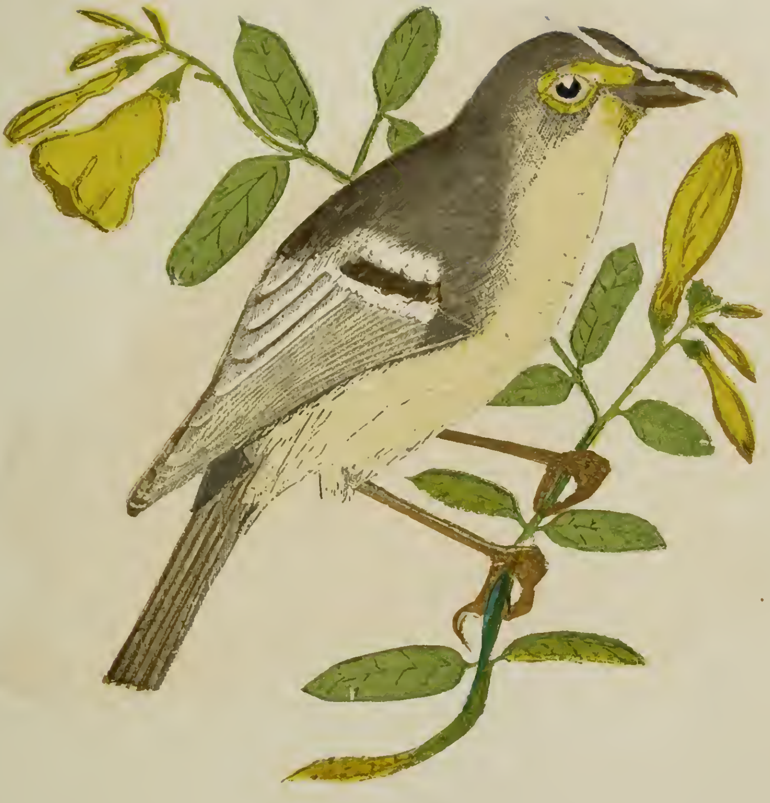
The tongue is flat and horny, deeply bifid at tip, but not ciliated (See fig. 31, A). The trachea is straight, .90 in length to the inferior larynx, which is well developed, and provided with the usual number of laryngeal muscles (six pairs, including the sterno-trachealis) and are all well developed.

The heart is rather round, quite small, .40 by .25. The right lobe of the liver greatly exceeds the left in size.

There is no indication of any dilitation of the oesophagus, which measures 1.25 to the proventriculus, which organ (See fig. 31, A, b) is provided with simple oval glands, arranged in a zonular band, which measures .35 in width.

The stomach (fig. 31. B, a,) is well rounded, but flattened somewhat laterally, .55 by .50 by 35, with the walls not very muscular, .10

PLATE XII.



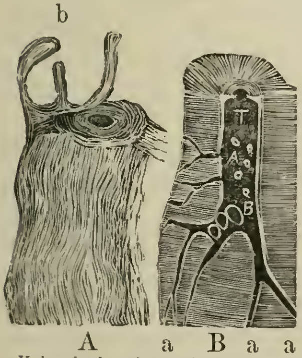
Thick-billed Vireo.
Life size. Type form adult male.
Nassau, April. 1888.

sponge in some specimens, but I have never seen any rounded clusters, the inclination of growth of new cylinders appears to be from the outside of the outermost of the older growths, thus a flattened laterally-elongated sponge is produced.

SKELETON.

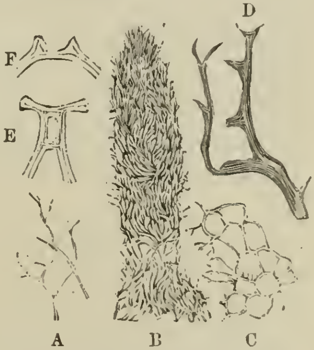
The color of the skeleton is light amber, and the fibers are much more delicate in structure than are those of V. fistularis, consequently the whole structure is less dense. The meshes are also elongated, longitudinally, that is, in the direction of the length of the tubes and filaments. (See fig 21, A, and fig. 30, A, B, and C.) Production of new twigs is by division, while there are arrested growths as in V. fistularis, and from the same causes as I have there given, (See fig. 30, A, where I give a new growth, much enlarged, also E and F, where I show arrested growths). In the elongated filaments which I have judged will never produce oscules, I find that there is the same flattened antler-like growth that I found in the abortive filamentos processes of V. fistularis. As I have never seen an undoubted instance where a new growth has anastomosed with a old, I cannot state whether this is accomplished as in V. fistularis, or not, but see no reason why it should not be.

FIG. 29.



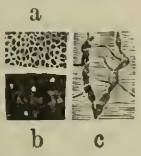
V. insularis. A, terminal portion of cylinder. b, filaments. B, section of same. A, excurrent orifices, a, a, a, B, branches of tube, T, central tube and membrane, Both enlarged four times.

FIG. 30.



Skeleton of V. insularis. A, C, portion of the skeleton enlarged four times. B, filament enlarged D, antler-like growth of filament. E, F, arrested growths.

FIG. 31.



Water system, V, insularis. a, incurrent orifices, b, excurrent, c, cilia cells.

HABITS AND DISTRIBUTION.

The Filamentos Sponge appears to be one of the most local in distribution of any of the members of the genus Verongia. I know of a single locality only where it occurs and here it grows in a very restricted area. This is a sandy bar which extends from the eastern end of Hog Island into the channel which divides this little island from a neighboring key, which lies to the eastward. That portion of this bar that is inhabited by these sponges is never exposed by the falling tide, so that the Verongias are always under water, although sometimes they come very near the surface. They are beautiful objects when in their native element, especially specimens like the one given on Plate XI, as then the long yellow filaments wave gently in the flowing current, closely resembling the branches of some of the algae. When the sponge is living the filaments have a tough, rubber-like consistency and are then not easily broken; but, when dried, they are exceedingly brittle. Their former elasticity may be in a great measure restored to them, however, by placing the sponge in water.

The Filamentos Sponge is always attached to a rock or coral, but these bases were surrounded by sand on the bar where I found them. There were a few other species of sponges growing there, notably a dark purple species of Pandaros, a spiculiginous sponge, and a few others of this group, but although some of them were parasitic in habit, none grew on the Verongia nor did I ever find it attached to other sponges.

This bar, or rather that portion of it on which this species grew, was about a hundred yards long by fifty yards wide, and even here the sponge was not very common. I found about twenty-five specimens, and these were all I ever saw anywhere, although, according to Duch. et Mich., the species occurs about St. Thomas.

COMPARISONS WITH ALLIED SPECIES.

There are no very near allies to Verongia insularis, for both in habit, as well as in other respects, it stands quite widely apart from all other species of the genus. The nearest ally, both in color and otherwise, is the Yellow Rope Sponge, Verongia fulva, but this grows in quite deep water, and has the oscules on the sides of the long, rope-like projections, which anastomose freely with one another; the oscules are also shallow, never deep and terminal as in V. insularis. For further comparisons see Verongia fulva, in Vol. III of these Contributions. From other species of the genus Verongia it is easily separated by the peculiarly flattened form, deep terminal central tube of the combined cylinders, and irregular filaments.

HISTORY.

The history of this species, as far as it is known to science, is quite easily written, for the species has either been overlooked, or misunderstood, by most writers upon sponges. So generally had this been done, in fact, that at first I supposed that the sponge had never been named, and in a sale catalogue, published in 1893, I called the species Verongia filamentos, and it was only after a careful study of Duchaissing and Michelotti's excellent work on the sponges of the Carribean Sea, which I have so often cited, that I saw that I was mistaken, and that these authors had described it, as cited at the head of this article. No one else appears to have paid any attention to the species until Prof. Hyatt, in 1875, mentions it, but, as before remarked, through unfamiliarity with the living sponge, gives it as a synonym of Verongia fistularis; considering this and its nearest ally, V. fulva, as only forms of the Orange Tube Sponge. (See Rev. N. A. Porif., Part 1, p. 402.)

CONCLUSIONS AND SUMMARY.

In the Filamentos Sponge we find a small species living in shallow water having flattened, cylinders arranged side by side, usually in a single row, but occasionally in a double row, never growing in connected clusters. The tubes are furnished with filaments, that growing upward, often become thickened, and then acquire an oscule at their termination, which deepens by the sponge growing upward around it to form a new cylinder. Another method of cylinder formation is by budding at the base, as in V. fistularis. Another, rare, method is by oscules forming in the sides of cylinders. As a kind of abnormal growth the filaments are sometimes greatly elongated into very slender processes, then they do not produce oscules but occasionally anastomose with one another. This shows a tendency toward what must be considered as a presagement form of extreme of individual variation, from which form, when it chanced to be placed under favorable circumstances for development, no doubt, arose the closely-allied species, V. fulva. V. insularis was also probably the originator of V. rigida and through this, but more remotely, of V. fistularis, hence it is that we find the occasional filaments about the summits of the cylinders in V. fistularis, but now as a useless reversion character. (See fig. 13, page 48.)

NOTES ON WEST INDIAN BIRDS.

The following article is a continuation of a series began in these Contributions, Vol. 1, page 171.

LARGE-BILLED VIREO.

Vireo crassirostris.

Plate XII, and fig. 31.

Vireo crassirostris Bryant; Proceedings Boston Soc. Nat. His., Vol. VII, 1859, p. 112.

DESCRIPTION.

Sp. Ch. Size, somewhat larger than that of the White-eyed Vireo, Vireo noveboracensis, with the bill proportionately larger; in color, grayer above, and uniformly washed with yellowish below.

The bill is quite long and thick, being as high as it is wide; the upper mandible is well curved at the tip and quite deeply notched.

The first primary, (spurious quill) is quite long, exceeding in length one half the second. The second is equal to the ninth, and the fifth is longest, but the third and fourth are but little shorter. The feet are large.

The tongue is flat and horny, deeply bifid at tip, but not ciliated (See fig. 31, A). The trachea is straight, .90 in length to the inferior larynx, which is well developed, and provided with the usual number of laryngeal muscles (six pairs, including the sterno-trachealis) and are all well developed.

The heart is rather round, quite small, .40 by .25. The right lobe of the liver greatly exceeds the left in size.

There is no indication of any dilitation of the oesophagus, which measures 1.25 to the proventriculus, which organ (See fig. 31, A, b) is provided with simple oval glands, arranged in a zonular band, which measures .35 in width.

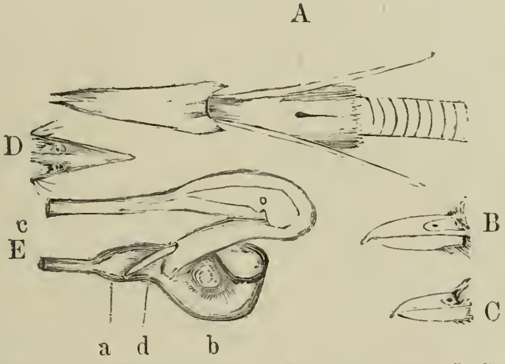
The stomach (fig. 31, B, a.) is well rounded, but flattened somewhat laterally, .55 by .50 by 35, with the walls not very muscular, .10

thick. Lining membrane, not rugose, but wrinkled and black in color.

The fold of the duodenum (fig. 31, B, c) is short, inclosing an irregularly formed pancreas (ib. o) which extends along the intestine. The spleen (ib. d) is a cylindrically-shaped body, .35 long, lying mainly on the proventiculus, but encroaching slightly on the stomach. The intestines are 4.40 long, and the cocca are very small and rudimentary, being only .10 long, and adhere closely to the intestine.

Color. Adult male. Above, olivaceous green, strongly tinged with ashy on the head and back, but clearer on the rump and upper tail coverts. Wings, brown, narrowly margined internally the whole length of the secondaries and inner primaries, and on the basal portion of the others, with yellowish white. Primaries and outer secondaries narrowly margined externally with greenish, which becomes yellowish, white on the terminal portions. Terminal portion of both rows of outer wing coverts white, forming two bands about .12 wide across the wing, and the outer of these connects with a broad margin, on each of the inner secondaries, of the same color. Under wing coverts, silky white. Edge of wing at carpal joint, yellowish white.

Fig. 31.



Digestive tract, etc., of the Thick-billed Vireo, life size. A, tongue; B, digestive tract; a, proventiculus; b, stomach; c, duodenum; o, pancreas; d, spleen.

Tail, dark brown, the feathers narrowly margined and tipped with white, externally with greenish. Sides, head and neck, greenish tinged with ochraous. Line from nostrils to eye, and a narrow ring around latter, broken before, behind, and above, sulphur yellow. Beneath, uniform pale ochraous yellow. This yellow of the lower portions gradually grades into the olivaceous of the upper parts on the neck and sides of head, but is separated on the latter by a blackish line which shows a slight inclination to appear below the eye. thus breaking the yellow ring in two places. The sides and back are also tinged with greenish. Bill, dark brown, bluish at base of lower mandible. Feet bluish, iris, grayish.

Adult female. The only difference in the type female, which I have selected, from the type male, is that the bill is more slender and less strongly curved at tip, compare fig. 27 C and D, with figure of male on Plate XII.

DIMENSIONS.

Wing, 2.65: tail, 1.65: bill, from base, .60; from nostril, .40: taisus, .75: first, or spurious, primary, 1.00; second primary, 1.75.

OBSERVATIONS AND VARIATIONS.

The 4th and 5th quill are, in many cases, the longest, sometimes one slightly exceeds the other, or both are of equal length. thus, out of seventy-four specimens examined, in nineteen the 4th was the longest: in twenty-five the 5th: and in twenty-nine both were equal, while one had the 4th, 5th, and 6th, the longest, and one the 6th. In fifty specimens the 2d quill was equal in length to the 9th: in twenty-two to the 10th: in two to the 8th; and in one to the 11th.

In size there is some variation, especially in size of bill, the largest being .38 long from nostrils and .20 thick, while the shortest is only .32 long by .18 thick. The longest wing measures 2.75: the shortest, 2.45. Longest tail, 2.25; shortest, 2.00. Longest tarsus, .75, shortest, .20.

Variation of color is also considerable, but is largely due to wearing away of the tips of the feathers or to the fading of them, and although the color below is sometimes quite pale, even in unworn plumages, it is always so when the tips of the feathers are gone, as they are lighter between the yellow of the terminal portions and the plumbrous base: above, however, the green appears to fade into a decided grayish white, the wing markings becoming quite narrow. In some birds there is a somewhat strong rufescent tinging on the top and sides of head and neck and across breast, but this may possibly be a mark of immaturity. The iris in some birds is decidedly grayish white but in others it is quite brown. In comparing Vireo crassirostris with specimens of V. noveboracensis taken at Florida, to which species it is closely allied. I find that the wing formula is about the same, thus out of forty specimens of the White-Eyed Vireo I find that eighteen have the 4th quill the longest; nine, the 4th and 5th; ten, the 3d; three, the 5th; six, the 4th and 5th; and three, the 5th and 7th. Out of ten specimens of V. maynardi from Key West, four have the 2d quill equal to the 9th; four to the 10th and two to the 8th. As a rule, in V. crassirostris the 1st quill is longer than one half the 2d, but in a few cases it is about equal to one half, while it is never shorter than one half the 2d, but in V. noveboracensis a few only have the 1st quill longer than one half the 2d, and the majority have it shorter. In size it is quite possible to match the two species, but crassirostris averages larger.

The bill of many specimens of Key West Vireo exactly matches both in size and form those of a large number of V. crassirostris. Thus in separating a large series of birds of either species one from the other we are obliged to consider color alone. Here, although there are differences, they are not as marked in some cases as one would suppose. Thus two specimens of the two species V. crassirostris and V. maynardi, now before me, are so nearly alike above that no one, even the most careful observer, could distinguish one from the other: beneath, however, there is a slight difference, crassirostris being more generally suffused with yellow, especially on the throat and middle of the body. This slight difference is all that absolutely separates the two species in some cases, for, although the yellow ring around the eyes of V. maynardi is usually complete, it is frequently broken by the olivaceous encroachment above, observed in V. crassirostris, and the color above on the wings of the two species is similar. I do not wish to be understood to say, however, that the two birds are one species, for they are quite different. I merely wish to show that V. crassirostris is only an insular species averaging larger with a slender bill and with lighter coloration.

NESTS AND EGGS.

NESTS, placed in trees or low bushes, never at any great height from the ground, pensile like those of other Vireos, composed of bits of palm leaves, pieces of bark from the gumbo limbo and other trees, stalks of weeds, dried grass, leaves, etc; the whole held in place with the webs of spiders, a pale green cotton-like fiber, lined with bits of grass, leaves, silk, cotton, etc. Another nest is partly covered with bits of moss and lichens and lined with dried leaves. Other nests, of which I have five or six before me, are made of similar material: external diameter, 3.00; internal, 2.25; external depth, 2.50; internal. 1.50.

EGGS, two or three in number, oval in form, pure white in color, dotted quite finely on the larger end with black. These spots are round, seldom confluent, and excepting a few scattering dots are confined to the larger end. There are also a few small dots of paler color. Dimensions, .57 by .75 to .53 by .75. In another set of two the eggs are more sparingly dotted than in those described, and each black spot on the end of one is narrowly surrounded by a ring of reddish; one is smaller than the other, dimensions, .53 by .75 A single egg is finely dotted with dark reddish mainly on the larger end. This egg is large, measuring .60 by .77. A single egg is very uniformly spotted throughout with reddish, but this is quite unusual, for eggs collected, excepting those mentioned, agree closely with the first two sets described. In fact, eggs with black spots, either with narrow reddish rings around the spots, or without them, appear to be the rule. The eggs of this Vireo resemble those of the Warbling Vireo more nearly than they do any other of our Eastern species, but they are even more sparingly spotted than those of this Vireo, and the spots are smaller, while the nests both in structure, size, and manner of building, resemble those of the White Eyed Vireo.

HISTORY OF THE SPECIES.

The Thick-billed Vireo was discovered by Dr. Henry Bryant on New Providence, near Nassau, in 1859, and described by him, as cited at the beginning of this article, in the Proceedings of the Boston Society of Natural History, Vol. VII, pages 112 and 113, published in September, 1859. As he says, he found three specimens only, all in the midst of a clearing, about three miles from the city (Nassua), on a road leading to the south side of the island. The first specimen was procured in March; the other two, a pair, in May.

Now as this Vireo is one of the most abundant birds on the Bahamas at the present time, as all who have collected there bear witness, it is singular that Dr. Bryant did not find more. He made two trips to the islands, one in 1859, when he remained from Jan. 20 to May 14, and another in 1867, when he remained until April, but does not say at what time his visit began. Judging from the places that he visited, however, he must have been there at least three months. The islands visited by Dr. Bryant with which I am familiar and on all which I have found the Thick-Billed Vireo very common are New Providence, Andros and Inagua. So abundant is this Vireo on all of these keys, that, excepting at night and during very windy weather, it is extremely difficult to find a spot anywhere near the scrub, where one cannot almost constantly hear their conspicuously loud and characteristic notes, that by their prominence could not at once fail to attract the attention of any one interested in birds.

Dr. Bryant was a most excellent observer and no one who knew him could for a moment doubt that had the Vireo been on the Bahamas at the time of his visits in any numbers but what he would have found more than three. We are therefore forced to the conclusion that they were exceedingly rare upon the islands in 1859 and 1867.

Now comes the important question, Was the Thick-billed Vireo not only new to science when Dr. Bryant discovered it, but also a recent addition to the avi-fauna of the Bahamas; in short, had this species come into existence so recently that individuals were yet very rare?

Of course it is barely possible that the Thick-billed Vireo had become rare at the time of Dr. Bryant on the Bahamas, through some accidental cause, but it is so improbable that any event should have occurred to nearly exterminate a species so wide-spread as this in several large islands at one time, that such an exigency is scarcely worth considering.

If the Thick-billed Vireo is of recent origin, the parent stock is doubtless Maynard's Vireo from Key West, for as we have seen the differences between the two species are really very trifling, but, on the other hand, we find (as will be seen upon comparing the habits of the two species) that there is considerable difference in song and breeding habits, yet we find Dr. Bryant saying, speaking of the first he found, "When I first saw it I mistook it for a White-egged Vireo. I noticed nothing remarkable in its habits." Has the species as it has grown older acquired more distinctive habits and notes? Certainly now the two species are very different, insomuch so that I do not think it possible for an ornithologist to mistake one for the other.

Two other interesting features present themselves in connection with this problem. First, and this I consider very important and one worthy of careful consideration, is the fact that there exists on a few of the islands of the Bahamas a second form of Vireo closely allied to the Thick-billed for the discovery of which we are indebted to the discerning power of Mr. Ridgway. I refer now to the Vireo flavescens which differs in being more yellow below, darker above. Mr. Ridgway's types came from Run Cry and Conception Island, two keys almost within sight of one another.

In April, 1883, I found this form on both Green and Little Galden Keys two small islets of a few acres each which lie off the east side of Andros. My attention was first called to this form on those two latter named keys by its singular note which differs enough from that of the song of the Thick-billed, which occur on the main island of Andros, only a few miles away, to be at once distinguishable to the ear of an expert. Now as the oddest part of the story, I have to say, that, although I never have collected birds on the keys from which Mr. Ridgway's types came, I had in 1884, eight years before, made a careful examination of both Green and Little Galden Keys, but then I did not find a single Vireo of any description upon either of them. I also took a single specimen of V. flavescens on a little key south of Highburn Key, March 27, 1893, but I do not think that I heard this bird sing. On Highburn, however, I found the ordinary form of the Thick-billed. Is this form now comparatively new to the fauna of the Bahamas and is it extending its range either from some one location or through the mysterious agency of evolution, acting simultaneously over an extended area? In time, now that we have the facts of its first appearance recorded, we shall by constant observation be able to answer these questions.

The second interesting feature in the problem is the presence of a Vireo on the islands of Cayman Brac and Grand Cayman, which although they have quite correctly been described as a species by Mr. Cory as V. alleni, so closely resemble rather pale Thick-billed Vireos as to be distinguished from them with great difficulty. I studied them living, and collected specimens on the island of Cayman Brac in the spring of 1888, and found their habits quite similar, but the oft-repeated call notes, or fragmentary song, of which I have spoken at length under the head of habits, were given with less energy, each being more prolonged, and consequently each was not as distinctly uttered as with the Thick-billed Vireos. Now what is the origin of Allen's Vireo? Shall we look for its ancestors among the Vireos of Central America, or were they also White-Eyed Vireos?

I am inclined to think that the former hypothesis is the correct one, not because over three hundred miles of water and the island of Cuba intervenes between the Caymans and the nearest point occupied by the White-Eyed Vireo, namely Key West, but because we find on the Caymans a similar instance of avian distribution. Here we have a Certhiola, named by Mr. Cory S. sharpi, which closely resembles the Creeper found on the Bahamas (C. bahamensis) differing from it in being slightly darker on the throat, and paler above, with a few other minor differences, while its habits and notes are very similar.

Now I look upon the presence in the Caymans of both a Vireo and Creeper, closely allied to Bahaman species, as due to the fact that climate and environment in both groups of islands are almost identical, and so both derived, even through changing species, from a common ancestor, speedily assumed nearly identical characters, when placed under similar environments.

This hypothesis does not affect in any way the idea that the form was derived directly from the White-eyed, for both Allen's and the White-eyed might have had a common ancestor, then the Bahaman form was the result of White-eyed having been placed under similar environment as that which produced Allen's.

It remains to be seen whether Allen's Vireo will in time evolve a yellow-breasted form such as we now find on the Bahamas. Singularly I looked in vain for any Vireo on the island of Little Carman, which lies only five miles distant from Cayman Brac, but Sharpe's Creeper was common there..

HABITS.

Upon our first arrival in Nassua we found the Thick-billed Vireo, remarkably common, their singular notes being constantly heard in all directions, where there was a thicket sufficiently large to afford them shelter but were the most abundant in the very midst of the dense tangled coppices. They were abundant on New Providence until February 9, when we noticed some diminution of their numbers, but they were always fairly common, up to the time of our departure, on this key. We found them in equal numbers on Andros and on the out-lying keys to the eastward of this island, but, strangely enough, did not find them at all common south of Grassy Creek, in fact, the only specimen that we obtained from this part was one out of a pair that we found on a small key among the mangroves on the south shore. These birds were not singing, nor did we hear a single Vireo's note, either here or among the out-lying keys off the eastern shore of Andros Island. We did not hear nor see them on Green Key, off Andros, June 6, but found them common and singing on the Ship Channel Keys a day later.

Although resembling the White-eye in some respects, in habit, the Thick-billed Vireo has so many characteristic ways as to render it a remarkable bird. To be sure they have the deliberate movements so noticeable in members of the family and whether clinging head downward to some mango twig, or climbing up a perpendicular stem of a shrub, they are never in a hurry.

As before remarked, they were every where, and on still mornings their peculiar and varied call notes could be heard on all sides. The boys call them Old Witches on account of some of their notes for some would say quite distinctly, "You old witch," while others vociferate, "I'll give you a lick, you old witch," always giving it that peculiar Vireo-like intonation, thus sounding as if they had some peculiar spite against the individual to whom they were addressing this obnoxious sentence, yet when one sees the deliberately moving, plain colored little bird whose vehement accents are so notable, the contrast between his modest behavior and aggressive statements are so great as to render them ridiculous, and we have many times paused to watch the birds in amusement. They are exceedingly inquisitive and often when we were pursuing our way along the narrow paths in the thick scrub we would be surprised to hear a murmuring sound and perceive a little bird within a foot of one's head. clinging to the outermost twig of the shrubbery calmly watching our movements. The low murmuring note is evidently used as a call for the female, or, rather, for conversation with her, for when the male appears first and utters this sound the female, which was never far away, came to examine us, also joining with her mate in conversing about us, with the same softly given murmur. The females are, if anything, more unsuspicious than the males and would linger about us, long after their partners had withdrawn into the scrub.

This species appears to be constantly mated, even as early as January 22, we found them in pairs. They are, like other Vireos, extremely affectionate birds and are very solicitous for one another's safety and if one be shot the survivor wanders about the neighborhood uttering the murmuring note searching for its lost mate.

All through January we heard these peculiar notes, notes so varied that although the intonation is sufficient to distinguish them from those of other birds it is difficult to believe that they are produced by the same species. At one time I endeavored to write down the various sounds, or combinations of sounds, and I found that certain series of notes were repeated by all of the males, for example, the "old witch" series as given above. Others were so varied that one could pass from one bird to another all day and not hear any two giving exactly the same notes. I will give a few of the more common utterances, trken down from the birds as they uttered them: "Ta-ar-to-wit-to-wee. To-we-ar. Chuck-er-we-ie. Tic-ar-de-wis-it."

One more I will add which I heard on March 30, 1894, at Nassau, this was from a very young bird who distinctly and curiously uttered the words, "Take me with you."

How birds of the same species could give so many varied notes as a song, was at first a complete puzzle to us, but on the the morning of February 2d the mystery was completely solved. We had visited a little orange grove which grew near the scrub on a deserted plantation, when a male alighted on a little orange tree within a yard of our heads and began a musical programme which greatly excelled any thing which I ever heard from a Vireo of any species.

The song sung was a singularly sweet, continuoas warble with only enough of the peculiar harshness to proclaim that it was given by a Vireo. The bird sang for at least five minutes, without interruption, but a great part of the time had not passed before we perceived that the odd notes which we had hitherto considered as the song were really only fragments of the fair, continuous lay to which we were then listening. These were mingled, apparently without order, in the cantata now being given, but were so softened and so much more sweetly rendered, without any decided accent, that the whole formed a combination of musical sounds which would have done credit even to the American Mocking-bird.

Afterwards we frequently heard this song, but strangely enough it is only given late in the day, usually when the bird is resting, about noon, the earlier morning hours being devoted to the oft-reiterated fragmentary lays, these being uttered from the earliest daybreak until the latest twilight, for the peculiar notes of this Vireo are the first to greet the ear upon the appearance of day and, excepting the nocturnal species, the last bird notes to be heard after the departure of the sun at night.

As early as the 28th of January I observed a male courting a female by flying about her, spreading his tail and uttering quite rapidly a series of rather odd notes while she sat quietly watching him. These performances were more frequently witnessed as the season advanced, but not until early in March did the birds exhibit any indication of breeding. About the middle of this month we found the pairs following one another more closely than hitherto, and they were more irritable than usual, scolding us when we came near them with a soft, less gutteral, note, while the males were singing more frequently.

On March 17th I was crossing an old plantation which had been grown up to bushes in pursuit of some Anis when I came upon a freshly-built nest of a Vireo, placed in the fork of the limb of a low bush, some three feet from the ground, but in open sight. The nest was evidently nearly completed. I saw no birds at this time nor did I linger to look for any, for I was afraid that they might desert the nest, should they see me near it. On the 20th I once more visited the nest, but it was still empty, but better lined than at first, and although I could hear the male singing in another part of the plantation I did not see the birds. On the 27th the nest contained the eggs. They were warm, but the birds were not in sight: after waiting a few minutes, however, they both appeared, but to my surprise neither appeared particularly solicitous for the safety of their eggs. I secured the male for identification, and removed the nest. The embryos were slightly advanced in the eggs. The nest had met with an accident, for the bottom was partly torn out, nearly exposing the eggs from behind.

On the 20th of March I found a Vireo's nest built in a fork of a guava tree which grew on a plantation apart from other trees. This nest also met with an accident for a high wind blew it partly down and although I fastened it up again the birds never laid in it.

On the 27th inst., we found a nest in a Sappodilla tree which grew in the yard of a negro's house. This was placed in the fork of a limb about four feet from the ground and contained one egg in which the embryo was somewhat advanced.

On the first of April a nest containing three fresh eggs was brought to us by a friend who found it on the margin of the scrub in a limb three feet from the ground, and on the same date I found a nest on the extreme swaying limb of a mimosa which grew by the side of a much-used path. This nest was placed only some three feet from the ground. This nest was taken by a child, when it contained only one egg, and brought to me. A nest taken April 8th contained two eggs, with the embryos so far advanced that I could not blow them, but another taken the same date from a nest some five feet from the ground contained two nearly fresh eggs.

About this time we left New Providence, and thus until our return could not watch the breeding habit of this species, as on

Andros our time was mostly occupied with the shore birds. Upon our return, while at Nassau, on May 24th a nest of this Vireo was brought to me containing three fresh eggs and on the 30th inst. I secured a nest built on the outermost twigs of the low limb of a mango four feet from the ground, containing one fresh egg.

It is quite probable that the nests found late in May are a second litter, but I could not find a single young Vireo, although I searched diligently for them up to the time of our departure, June 12th. Thus we may consider that the Thick-billled Vireo began to breed about the middle of March, then a second time late in May or early in June. Just before our departure, when the birds were in summer plumage, I noticed that the males were not singing as commonly as usual. In no instance did the birds exhibit any more solicitude when the nests were disturbed than I have recited concerning the first nest found, but in only one case was the female ever found on the nest, then she was captured by the negro boy who accompanied me ; I took her home and give her the liberty of the room in which we worked. She quickly flew up and alighted on some timbers that crossed beneath the roof and remained on them all day, flying from one to the other or darting out into air in order to snap up some passing insect which she caught with great expertness. Noticing that she appeared stupid, the next day she was liberated, but even then was in no hurry to take her departure for she remained in an almond tree, which grew in the yard, for an hour or more.

The diet of this Vireo although consisting largely of insects is occasionally varied by berries, especially by the peculiar resinous fruit of the gumbo-limbo.

DISTRIBUTION.

In the following account of the distribution of the Thick-billed Vireo, as I have observed it, it will be understood, unless otherwise distinguished, that this species is confined to the scrub or general low growth of more or less tangled thickets, which spread over a greater portion of the Bahama islands. This species does not occur in the pine woods nor in the gardens about houses, excepting occasionally when those are in the direct neighborhood of some thicket. The species is constantly resident wherever it occurs.

The Thick-billed Vireo is found abundant throughout New Providence, on Hog Island, and other small keys to the eastward, at least as far as Green Bay; common, but not abundant, on Andros, from Calabash Bay south to Middle Bight, but not on the small outlying keys. None seen at Grassy Creek, and only a single pair (the one taken was very pale in color) observed on the keys along the north shore, hence on Andros nearly confined to the region which lies north of Southern Bight, and east of the central pine forests which extend through the interior of the islands. Common on Green Key, off Andros, but on the eastern side of Tongue of Ocean. Highburn Key, common, but not abundant. Norman's Key, a few. I found them fairly common on Inagua, singing their fragmentary song all through February, 1888.

As far as my observations go, it is evident that the Thick-billed Vireo is most common on the island of New Providence; in fact, on the eastern end of the island, and on Hog Island it is the most abundant of all the bird kind, and as we radiate out from this center their numbers decrease, but not always proportionately, thus they are about as common on Inagua which is about three hundred miles from New Providence, as they are at Middle Bight, Andros, which is only about fifty miles from New Providence.

APPROXIMATE LENGTH OF LIFE OF THE BLUE BIRD. SIALIA SIALIS.

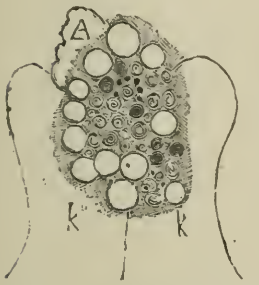
On June first, 1884, a female Blue Bird was brought to me for dissection, which I was informed had raised one brood of six young that season and had just finished laying her second litter of six eggs. Upon examining the ovary I found both of those facts so clearly indicated, and the remaining ova so distinct, that it at once occurred to me that a careful study of the ovary would lead to a fairly approximate idea of the life of this particular bird.

I have always believed that the females of all animals, or at least all vertebrate animals, had the germs of all the ova that they ever would have stored in the ovaries, awaiting future development, and that when they became sterile, it was not because they were of an advanced age, but because the ova had become exhausted.

Now as the plumage of this particular Blue Bird indicated that she was not more than two or three years old, I thought by counting the ova contained in the ovary, it would be easy to judge something of the natural length of her life.

The first thing that I observed, was, as is usual in birds even after laying the last lot of eggs for that season, that some of the ova were enlarged more than others. This is, I presume, a kind of provision in case of accident to the litter just deposited, in order that other ova may be in a condition to be brought forward for a fresh supply of eggs. There were twelve of these enlarged ova scattered somewhat irregularly over the ovary, but were inclined to mass rather on the left side which is the side furthest from the oviduct. (See fig. 32 where I have given a drawing of this ovary enlarged twice, the unshaded ova are the twelve which were enlarged). Six of them were slightly larger than the others: two of these were in the upper portion of the ovary and four in the lower. I next looked for the ruptured capsules of the six ova just dposited and found them also scattered irregularly over the more central portion of the ovary. These I have indicated by heavy shading and they are comparatively of a large size. I then traced the ruptured capsules of the eggs deposited early in the season, and found six of them all together, forming a kind of crescent near the upper portion of the ovary. In the cut I have indicated them by rather large black dots. A more careful search was now required to detect the ruptured capsules of the eggs of previous seasons, and I found twelve of those only. Thus it became evident that the bird was two years old, for she had deposited but two litters of eggs. These ruptured capsules were all together in the lower portion of the ovary, but there were only six in sight, as may be been by the small black dots over the line between k, k; the others were hidden by the enlarged ova. I now counted the small undersized ova, which made up the body of the ovary, and found seventy of them. Now by a simple sum in addition we find that there must have been originally one hundred and six ova in this bird's ovary before she had deposited a single egg. Hence if she deposited twelve eggs in a year, she would become sterile in between eight and nine years. Of course, if she lost a litter of eggs, occasionally, and was obliged to supply this loss her stock of ova would become exhausted sooner.

FIG. 32.



Ovary of a Blue Bird, Sialia sialis, enlarged twice. A, Adrenal, k, k, kidneys.

Now comes the question of how long any bird survives the period of fertility. From my experience I should say that they rarely survive the period of the complete exhaustion of the ovaries. For many years, with this matter in view, I have looked through the hundreds of birds which have passed through my hands for any evidence of exhausted ovaries, and excepting among the Terns of the Bahamas which were formally systematically and constantly robbed by the sponges, and which were thus obliged to lay at least three litters of eggs every season, in order to propogate their race, I have never seen any great approach to an exhausted ovary. In fact, the rule is that the ovaries of birds are very full. Hence, we may with safety conclude, that no bird long survives the period in which it is incapable of reproducing its species.

Of course, there are exceptions to this rule, and I have seen several among domestic fowls, but those that become sterile assume some of the characters of the male; they crow and in some cases acquire the elongated plumes of the male. There is also a specimen of a pea hen in the museum of Essex Institute that has assumed in a measure the train of the peacock. I have, however, had no opportunity of examining the ovaries of birds which were in this condition, but as they had ceased to lay, no doubt but what the ovaries were exhausted.

I have given a single example only of the number of ova in the ovary of a bird, but, when we consider that the number of eggs which a given species of bird deposits varies but little individually, it is quite probable that the number of ova in the ovaries will vary but slightly individually. Therefore we may consider that the average natural life of a Blue Bird is about eight years and that during that time if she does not lose any of her eggs she brought over a hundred young into existence. Yet, in spite of this fertility, we have only to note that there is no actual increase of Blue Birds in any section taking an average for a number of years, to understand that out of all this number of young only a single pair survives at the end of eight years. That is, each pair of Blue Birds simply places another pair of the species in the country which they have inhabited as the result of a life labor. Were this not a fact, Blue Birds would increase so rapidly as to soon become more of a source of annoyance than our English sparrows; even should every pair leave a two-fold increase of offspring there will be a noticeable augmentation in the number of Blue Birds in a very few years.

MONOGRAPH OF THE GENUS STROPHIA.

(Continued from Vol. I, page 197.)

I continue my article upon the genus Strophia with the additional advantage of another season's work among the Bahamas. In March and April, 1893, in company with Messrs. Curtiss and Thorndike I visited New Providence, and some of the adjacent keys, Highburn, U Key, and other keys about Allen's Harbor, Andros from Fresh Creek south to Middle Bight, taking in the out-lying keys off the coast. As will be seen by the following descriptions, my ideas regarding the limited distribution of species in this genus have not only not been changed, but my opinion in this respect has been greatly strengthened. Mr. Curtiss, who is an experienced naturalist, and who followed me in my investigations step by step, examining with me the Strophias in their native haunts, early became convinced of the justice of my conclusions regarding the species.

A careful study of the keys on which Strophia occur, with the idea of accounting for their distribution, has revealed two facts. One is, that these shells never appear on any key on which palms do not grow. Another is, they do not live on any key which is not now inhabited by man, or which has not been inhabited by him in the past, or which is not now frequently visited by him, or which has not been in bygone times a resort of human beings. Palms not only indicate a more or less fertile soil, but as they are useful to mankind in several ways, prove attractive to him: hence their presence is an index of a present or past occupancy of any key. And the shells are probably transported from place to place by man.

27 STROPHIA CURTISSII Novo.

Curtiss' Strophia.

Fig. 33, A, young; B, side view of type; C, front view of the same.

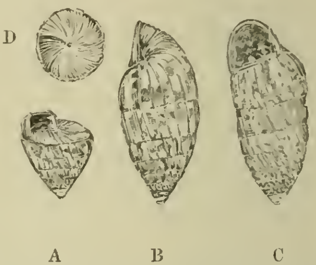
DESCRIPTION.

Sp. Ch. Size, rather below medium. Shell, rather thick and heavy. Striations, prasent. Animal almost wholly brown in color. Whirls, 10. Examined 2,000 specimens.

Form of shell, inclined to be cylindrical, the first and second whirls being nearly equal in diameter, and the third is but little smaller, then the shell slopes rather quickly to a quite blunt point, forming an angle of sixty degrees. The striations are quite numerous, twenty-six on the first whirl, not very prominent, rather irregular, and not arranged in lines; they are slightly inclined from right to left, are narrow, hence the interspaces are wider than the prominences. The striations are not furrowed, but are rounded and smooth.

Aperture, rather small, but measures a little more just within than at the entrance. Lower tooth, not very prominent, .05 high by .10 long, and its position is about central; the upper is absent, being represented by a slight protuberance.

FIG. 33.



Strophia curtissii. A, side view of young; D, end view of the same; B, side view of type; C, front view of same.

Margin, not produced forward as far as the diameter of the shell, and is very slightly inclined to the right, but not beyond the side; it is not thickened, measuring .04, but the outer posterior portion is produced backward into a sharpened edge, but which is not rolled downward. The frontal bar is quite distinct, and the striations are completely interrupted by it, never appearing within.

Color of shell externally, white, prominently and plentifully flecked with reddish brown of varying shades: internally, purplish brown, fading into yellowish white on the teeth and margin of the aperture and tooth. Apex, pale horn color.

DIMENSIONS.

Size of type, .98 by .40. Largest specimen, 1.23 by .42; smallest, .87 by .36; greatest diameter, .45; smallest, .35. Longest specimen, 1.25; shortest, .78.

OBSERVATIONS.

Individual variation from the typical locality is not great. There is a tendency to vary somewhat in fleckings, some specimens being more heavily marked than in the type and others less heavily. There are, however, three prominent departures from the type, which if placed under different environment at any time, will form distinct species, but which intergrade so completely with the type form that I have not considered it necessary to name them, but have designated them by numbers. The type form occurs in the large cemetery to the eastward of Nassau, on the western side of a path which crosses the grounds.

No. 1. Form of shell about that of the type, but this is a rather small form, .90 by .40, with a thicker margin, (.10), projecting more forward, smaller aperture, more striations, 31 on the first whirl, with the interspaces about as wide as the prominences. The fleckings are slight and much paler within than in the type, with no distinct blotchings. This form is inclined to occur to the westward of the type location.

No. 2. An elongated cylindrical form, with eleven whirls, the first three of which are about equal in diameter, and with the remainder forming a rather acute point, having an angle of 50 degrees. The striations are fewer than in the type, 21 to the first whirl, less prominent, but with lines of growth between. The margin is thick (.07) with aperture widening from within. The fleckings are inclined to mass into blotches, but their color is pale. This form occurs to the southward of the type location.

No. 3. Of about the same form as the type, but is a larger shell, 1.10 by .45, with a very thin margin, about .03, and apertures widening from within, striations 27 to the first whirl, very regular, but not in lines. Occurs to the extreme southward and eastward of the type location.

No. 4. Is a more pointed form than the type, narrowing from the first whirl. About the size of the type, with margin and aperture similar, but the striations, excepting on beginning of upper whirl, near margin, are reduced to irregular lines of growth, which are prominent only in places, leaving the shell quite smooth and polished in spots. The fleckings are massed in blotches and are very dark in color, contrasting with the creamy surface. This form is very rare. I found five only among some banyan trees that stand on the top of a little hill in the cemetery, near an old ruin.

No. 5. Rather singularly there is a form of S. curtissii on Spotter's Key, a little islet lying in the middle of Nassau harbor, distant from the cemetery about a third of a mile. This islet was formerly fortified, as the remains of old ramparts testify, and although now it is seldom visited, there must have been constant communication between it and the main island in former times. It was then doubtless that Strophia curtissii was introduced. Since then it has changed considerably. In fact, it has become one of the most interesting forms of the genus that I have seen. The form and color does not differ exceedingly from those of the type, but the size is somewhat smaller (.87 by .40). The margin is pushed forward almost to the outer diameter of the shell (in some specimens beyond this), and has become very thin. But the most important feature is the tooth, which is at least three times as long as high. (See Fig. 34 a, where I give a cut of this tooth, side and top view, and compare with ib. b, where is given a view of the type, S. curtissii). The striations are quite regular and arranged in lines.

Were it not for the fact that not every specimen on Spotter's Key has the tooth elongated to the extent shown in the type, I should not hesitate to consider this well-marked form as a species. I have elsewhere shown that on wind-swept islands, like the Caymans, species of Strophia have elongated teeth, in order that the animal may have better control over its shell, as it has no muscular attachment to it; and here on this little key, lying as it does in the middle of the harbor, the form I have just described, has, through the progress of evolution, acquired a similar tooth to those which characterize the Cayman Strophias.

Young specimens of Strophia curtissii have the central tooth missing, but with the upper well developed. There are, however, no other teeth whatever, as is usual in some other species.

Known from the closely-allied S. thorndikei by the larger size, less creamy color and thicker margin to the aperture.

From other of the short-toothed Strophias which occur on New Providence and in its vicinity, in which the central tooth is only twice as long as high, this species may be distinguished by the fleckings, combined with usual absence of the upper tooth. Occasionally this is present, but is then very minute but oftener the prominence given in the type is not even seen.

I have named this beautiful Strophia for my friend Mr. George F. Curtiss, to whom I am not only indebted for many acts of kindness when he was with me, but also for ready sympathy and encouragement in all my pursuits.

This common Strophia has found its way into collections under the name of S. zebra of Reeve, but this is not the S. zebra described by him and figured by him in his monograph. The true S. zebra is a shell without striations, but with lines of growth only, and with the markings massed together in large, prominent blotches. My friend, Mr. F. C. Browne, has some Strophias in his collection, labelled as coming from the west coast of Andros, which answer to Reeve's figures and description of S. zebra quite nicely. Unfortunately Reeve says his S. zebra came from the Bahamas, without giving direct locality.

HABITS AND DISTRIBUTION.

The first specimen of S. curtissii, that I ever saw was gathered by Mr. Curtiss from some bushes which grew near the western border of the pond that lies to the eastward of the city of Nassau and which is known as Waterloo. Here they are scattering and are mostly confined to the south side of the road which goes out to the beach near the old magazine, but I found a few dead shells west of this road.

Later we found the type locality, which was in the cemetery between Waterloo and the city. On the north side of this enclosure is the type locality. On the hill in the middle of the cemetery among the fig trees I found a sub-species (S. c. nivea) and to the eastward of a path crossing the cemetery, another species, S. thorndikei. On the hill was also the smooth form, No. 4. and in the valley beyond it a similar form to that found at Waterloo (No. 2) already described. Outside the cemetery wall to the westward I found a few, also large, coarsely-striated specimens. I could not trace them south of the southern wall of the cemetery, nor even quite to the wall. They are exceedingly abundant in the type locality, which occupied about a quarter of an acre. Here the bushes, to which they had evidently been clinging, had been cut down, and many of the shells were upon the herbage. In other places, especially toward Waterloo, they were clinging to shubbery; all were hybernating when we found them early in March, and they were often gathered together in clusters. When taken into the house they began to move about, after a time, but in most cases refixed themseves either to one another or to the sides of the boxes, in which they were kept.

The elongated form, No 3, occurs between the type locality south and the top of the hill and a little beyond it. Numbers 1, 2, and 3, are about equally common, each representing about one per cent. of the type form, but No. 4 is very rare, only five being taken.

I liberated a number of these Strophias in the yard in which we lived, on the corner of Bay Street and Kemp's Road, in order to see if they would survive, as a species, under different environment, and fully intended to have taken a lot to U Key, but failed to do so as we did not visit this key a second time.

Mr. Curtiss made an interesting discovery regarding the form which inhabits Spotter's Key, as he found three pairs which were on the ground clinging together for mutual fertilization. This was on March 27th, directly after rain.

28 STROPHIA CURTISSII NIVEA Novo.

Snowy Strophia.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, not very heavy. Striations present. Teeth, two, and both small. Whirls, ten. Examined forty specimens.

Form of shell, a pointed cylinder, with the first whirl the largest, then the next three are successively a little smaller, after which the shell slopes rather gradually to a point, forming an angle of 45 degrees. The striations are not numerous, twenty-two on the first whirl, are not prominent, are irregular in form, and not arranged in lines; they are narrow, being about one half as wide as the interspaces between them; are smooth and rounded.

Aperture, rather small, and slightly contracted at the entrance. Lower tooth, very short, about .02 high, and about three times as long as high. It is about central in position, and is set well back from the frontal bar, about .08. The upper tooth is also set well back, and is about as large as the lower.

Margin, produced forward nearly as far as the diameter of the shell, and is inclined very slightly to the right, the edge is very thin, about .02, and is produced upward into a sharp edge, but not rolled backward. The frontal bar is not very prominent, and the striations appear within it. Color, externally, pure white without fleckings; within the aperture, slightly tinted with flesh color.

DIMENSIONS.

Size of type, .90 by .37. Largest specimen, 1.06 by 47. Smallest, .82 by .38. Greatest diameter, .47 : smallest, .35. Longest specimen, 1.06; shortest, .87

OBSERVATIONS.

Variations are chiefly in color.

No. 1. Pure, snowy white without tinting of any kind, within or without. Striations even smaller than in the type and fewer; a single specimen of this beautiful form was obtained.

No. 2. Flecked slightly with pale reddish, and with more numerous and more prominent striations. Shell, thicker and heavier, with a thickened margin.

From this flecked form specimens grade, but through a very small percentage, into typical S. curtissii, hence I have not given the form full specific rank, as it is an example of an incipient species which has not become fully fixed. Known from all other Strophias by the short, central tooth and peculiar snowy whiteness.

DISTRIBUTION AND HABITS.

I found the Snowy Strophia clinging to the trunk and limbs of the banyan tree which stands near the old ruin in the cemetery, where Strophia curtissii is found. The back of the banyan is nearly white and the shell has assumed a protective color, and, as in most cases where a light form of Strophia has become evolved from a dark form, the shell has become thinner, thus reducing the size of the striations snd margin of the aperture. This lightening of the shell must prove beneficial to the animal in living on trees, but in spite of this, we find that in order to assist the animal to maintain control over its shell the upper tooth has not only become more prominent, but the aperture is contracted and its margin is extended forward.

No one can doubt the originator of this form of Strophia, as it is now easy to trace it back to its ancestor, and the lesson that it teaches us is of great importance in our studies of land shells, more especially of this genus. Strophia curtissii is a species which lives very near the ground, in fact, is frequently found on the ground, hence is liable to injury from many causes. Here we find the animal protected by a moderately heavy shell, flecked to resemble the mottled bark of trees and parti-colored herbage on which it lives. Some offspring of this mottled form ascends a white-barked tree, where they are no longer in danger of being crushed by the feet of passing animals, but are exposed to another class of dangers. Hence gradually through successive generations the animal secretes a shell better suited to its new method of life. First, it loses its color, then the shell grows thinner and lighter, but in order that the animal may grasp it more firmly and prevent its being blown away during the prevalent tempests which occur, when the Strophia must be actively moving about, in August and September, for there is considerable rainfall in both these months and mollusks of this genus move in damp weather, a tooth is developed, which is not usually found in the ancestor, S. curtissii, namely the upper, and the aperture is narrowed and its margin pushed forward. These are apparently slight alterations, but they mean much to this small animal, and are as comparatively important to it as more easily seen changes in other and larger animals. We have seen how the form of Strophia curtissii living on Spotter's Key has altered its shell to suit its new home. Now who can say but what the animal within the shell has not changed also. At all events, an important portion of the animal has changed. Now, when I maintain that such changes after becoming fixed, as in time they do become fixed, as we find they do in many cases in this genus, constitute good and sufficient specific characters, I may be indulging in the rankest kind of conchological heresy; but is not such heresy, when, guided by facts, I apply the truths of evolution, in which every thinking naturalist believes, practically, in the naming of species, better, as indicating progression in the right direction, than conservatism, which means stagnation? I simply trace the changes which those animal are undergoing and, believing as I do, that all animals have halting places in the great system of changes, I endeavor to indicate these halting places by imposing a name upon the animal, which, assuming certain characters, has become quiescent as a form, for a time.

I once again repeat, what I have had occasion to state many times, and be it remarked I speak from a long and extended experience, that the genus Strophia is exceedingly plastic, evolving species much more readily than many genera of shells. The species are exceedingly local in distribution, and slight causes isolate colonies, that when so isolated speedily assume characters consistent with their environment, and these characters I consider, as I am forced to do, looking at the whole matter broadly and consistently, as specific. In my account of the genus Strophia I have been very careful not to overstate anything, nor have I formed any theories unsupported by facts, and as far as I have gone I have not taken any steps which I wish to retrace.

I feel constrained to make these and similar remarks, inasmuch as I know that I am looking upon the matter which I have in hand, from a new and a widely different standpoint from which it has been viewed in the past. The correctness of my judgment may be, possibly justly, questioned, but I do trust no one will venture to pass an unfavorable verdict who has not been over the ground as completely as I have been over it, exploring those far away and often nearly desolate keys almost yard by yard, noting, and carefully recording, every attendant circumstance and surrounding that can possibly have any bearing upon the lives of these interesting mollusks. I care not what experience one has had with other genera of shells, for while it is true that this may assist him in many ways, it does not fit him to pass positive judgment upon the work of one who has had an extended experience in a genus of shells so peculiar as is Strophia. For be it remembered, it is a portion of my heresy to believe that we cannot always form cut and dried rules that will apply to all groups of any one class of animals, even though these groups be closely allied.

For an example, while we might, with perfect propriety, think a man very unscientific who would maintain that color variation, or the weight of the shell of the common Purpura lapillus, of our coast, were of the slightest specific importance, yet both of these characters (color and weight) are of vast importance, as I have repeatedly shown, in Strophia. Color, in a species of Helix (H. varia) which often grows side by side with species of Strophia, counts for nothing, specifically, as we find all gradations in this shell from pure white through a beautiful banded form to nearly black, nor is the weight of the shell of any great importance (although it may be somewhat so) in this species, nor is it, I believe, in any members of this genus. Why color should be important and protective in one group, and not in another, is difficult to say, but so it is. Nearly black specimens of the Varying Helix may be found side by side with white examples. Weight of shell means more with Strophia than with Helix as one animal (Helix) has a muscular attachment and the other (Strophia) has not: thus members of the genus Strophia, with a changed weight of shell, naturally are obliged to assume other vital characters which need not be assumed by a Helix when it changes the weight of its shell. Hence one may be well posted in regard to all the changing ways and characters of even so closely an allied genus as Helix and yet know very little of the peculiarities of the members of the genus Strophia.

But I think I have now said enough to convince any one that he ought, at least, to pause before giving an adverse opinion of my statements until he has seen as many of the members of the genus Strophia in their native islands as I have.

I did intend to leave much of the matter that I have given in these somewhat lengthy digressions, until I came to my general conclusions, after going completely through with my monograph, for I have been greatly encouraged by the confidence which many have shown in my work, especially among the rising generation of naturalists, but as I have read, here and there, some occasional allusions to my opinions in which the authors quite evidently judged me upon too general grounds, without looking into the heart of the matter, I thought it best to make these explanations. I now, however, will say that I have done, and shall make no more digressions of this nature until the completion of my work. This I will say, however, before quite ending the subject, should there now remain one doubting Thomas who still thinks that there should be given today no more species of Strophia, for example, than are given by Reeve in his monograph (some twenty-five, I think), and that I have been too expansive in my number of species, I now most cordially invite him to accompany me on my next trip to the Bahamas, which will probably be next spring, or on any following trip, and I will venture to say that I will show him more things in the genus Strophia than he ever dreamed of in his wildest philosophy.

STROPHIA THORNDIKEI Novo.

Thorndike's Strophia.

FIG. 34, D, front view of type.

DESCRIPTION.

SP. CH. Size, small. Shell, rather thin and light. Striations, present. Whirls, nine. Examined, 2,000 specimens.

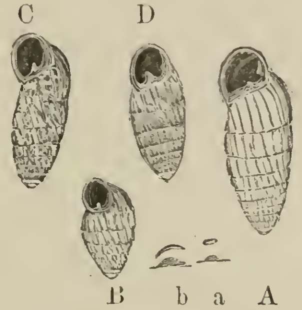
Form of shell, inclined to be cylindrical, the first and second whirls being about equal in diameter, and the third is but little smaller, then the shell slopes rather quickly to a blunt point, forming an angle of about fifty degrees. The striations are rather numerous, twenty-one on the first whirl, not prominent, rather regular, and arranged in lines; they are slightly inclined from right to left, are rather wide, hence are about as wide as the interspaces between them: they are not furrowed but are smoothly rounded.

Aperture, quite small, inclined to be rounded, and is slightly contracted at the entrance. Lower tooth, quite prominent, .05 high by about .12 long, is set well back, .08, is somewhat elevated and is placed a little to the right of the center. The upper tooth is well developed, being about half as high as the lower, but extends backward and makes a turn around the column.

Margin, produced forward nearly as far as the diameter of the shell. and is very slightly inclined to the right, but not beyond the diameter of the shell: it is thin, about .02 is not produced backward, but ends in a blunt edge, about the middle of its width. The frontal bar is well developed and completely interrupts the striations which do not appear within it.

Color of shell, externally, reddish white, flecked with longitudinal markings of reddish brown; internally, rather pale brown, fading into creamy white on the margin and frontal bar. Apex, horn color.

Fig. 34.



A. Strophia curtissii nivia, front view of type. D, Strophia thorndikei, front view of type. B, form No. 3, S. thorndikei, front view. C, form No. 4, S. thorndikei, front view.

DIMENSIONS.

Size of type, .70 by .30. Largest specimen, .95 by .36: smallest, .52 by .30. Greatest diameter, .38; smallest, .27. Longest specimen, .95; shortest, .52.

OBSERVATIONS.

Individual variation from the type locality seems to consist in color mainly, some being more flecked, as in S. curtissii, and in size, the largest approaching even typical S. curtissii, and are probably reversions toward that species but they maintain the nine whirls, thin margin and other characters given above. There are the following well-marked forms:

No. 1. Form, size, and markings similar to those of the type, but the margin is heavier and the upper tooth is absent, but the lower is elongated as in the type. Found around the borders of the type colony, and constitutes about one quarter of all the specimens collected.

No. 2, differs from the type in being unflecked, the color being reddish white, in having the striations smaller and more numerous, twenty-seven to the first whirl; but, rather singularly, the margin is heavier. The size is a little larger than that of the type, .80 by .55. The central tooth is greatly elongated, being three times as long as high, but the upper tooth is absent. Specimens vary a little, some being larger than the type and some show slight fleckings, others have the upper tooth. I have remarked that the bushes in the cemetery where this shell is found had recently been cut down and left on the ground. Thus it was impossible for me to tell whether this unflecked form occurred on them, but I should judge that it might have lived above the ground before it was distributed. As I could not assign a locality for it I have given it as a form only of S. thorndikei.

No. 3, is a remarkable form of shell. Short, shell with eight whirls only, top shaped, with the upper whirl the largest, and with the aperture nearly oval with the lower tooth central in position (see fig. 34, D, front view. The size is very small, .52 by .30, and the fleckings are about as in typical thorndikei. I found this dwarf form in the very midst of the colony of S. thorndikei, but living on the ground, and among them were mingled some typical S. thorndikei. There were about one per cent. of both Nos. 2 and 3 in proportion to typical S. thorndikei.

No. 4 is a slender, cylindrical form with the first three whirls equal in diameter and the margin thrown well over to the right, the upper tooth missing, and the frontal bar is oblique and inclined to the right; very dark in color, with heavy fleckings, and the color within is also very dark brown. Although I have but a single specimen only of this form I have considered it remarkable enough to mention. Fig. 34. D.

No. 5. Of the form and size of the white form, No. 2, but pale brown throughout, slightly flecked on the striations with white. I have a single specimen only of this form, but mention it as it is remarkable.

HABITS AND DISTRIBUTION.

There is a path which crosses the cemetery from the entrance that is quite frequently used, and thus being kept free from herbage, it forms a kind of barrier which prevents a mollusk like Strophia from crossing readily. S. curtissii occupied the land to the west of this path, but midway between the gate of the cemetery and the hill of which I have spoken in the account of the preceding species I found the colony of S. thorndikei, but to the eastward of the pathway which thus isolated them from the Strophias on the western side.

Most of these shells were on the ground or on the grass near it and occupied in all about one hundred square yards, being thus extremely limited in distribution. The colony had recently been much disturbed by the cutting of the bushes over and about it and some specimens had been thrown across the path, thus it was difficult to trace out the location of the various forms. Thorndike's Strophia was quite abundant in this place, but I could not trace it elsewhere and am sure that it did not extend its range beyond the borders of the path to the westward, nor beyond the cemetery wall to the eastward, and not over ten yards north and south. All specimens were hybernating when we found them.

I have named this species for Dr. T. W. Thorndike, of Boston, an enthusiastic naturalist, who accompanied me on the expedition to the Bahamas.

30 STROPHIA CINEREA Novo.

Cinerous Strophia.

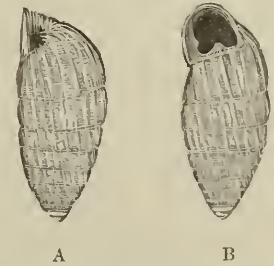
Fig. 35. A, front view ; B, side view, both of the type.

DESCRIPTION.

Sp. ch. Size, rather large. Shell, not very thick. Striations, present. Animal, dark brown in color. Whirls, ten. Examined 2,000 specimens.

Form of shell, cylindrical, the first three whirls being about equal in diameter, the fourth is but little smaller, then the shell slopes abruptly to a blunt point forming an angle of sixty-five degrees. The striations are quite numerous, twenty-five on the first whirl, rather prominent, regular, arranged in lines, slightly inclined from right to left and a little narrower than the interspaces between them : they are not furrowed, but are rounded and smooth.

Fig. 35.



Strophia cinerea. B, front view of type. A, side view of the same.

Aperture, rather small, rather open, but narrows quickly from the entrance. Lower tooth, not prominent, short, about 04 high, a little more than twice as long as high, and its position is about central, but quite near the frontal bar, about .07 : it is not elevated ; the upper is represented by a slight protuberence.

Margin produced forward as far as the diameter of the shell, slightly inclined to the right a trifle beyond the diameter of the shell, is thickened only on the left side. and here but slightly, about .03. On the right it is reduced into a sharpened edge that projects forward : on the left the margin is smoothly rounded, but behind it is developed a roughly sharpened lateral edge. The frontal bar is narrow but prominent, projecting well forward, completely interrupting the striations.

Color of shell, pale brown, somewhat mottled with white, but with the striations ivory white. Internally, light brown, becoming a little paler on the margin.

DIMENSIONS.

Size of type, 1.15 by .45. Largest specimen, 1.15 by .49. smallest, .83 by .37. Greatest diameter, .50 ; smallest, .36. Longest specimen, 1.23 ; shortest, .83.

OBSERVATIONS.

There is considerable individual variation even in the type locality of this Strophia, and, judging from my past experience with this species, which extends over a period of about ten years, there is some danger of the type form becoming extinct. Of this matter, however, I shall be able to speak more positively, I trust, in my next instalment of this Monograph, the inclinations being to a form with coarser striations and fewer of them. There are also three decided forms which are as follows :

No. 1 is a small form, .83 by .37, with numerous striations, twenty-nine to the first whirl ; aperture, more contracted, with a thinner margin and with the color white, slightly mottled with very pale brown. This form occurs in the type locality, and forms about fifty per cent. of the whole number found.

No. 2 is about the same size and form of the type but much darker in color, the interspaces being dark brown, and the striations pale brown : the interior is also dark brown, pale on tooth and margin, nearly white on lower side of frontal bar. The striations are narrower, being about one half the width of the interspaces. This form occurs along the beach of Middle Bay, Hog Island, east of the type locality, and is not very common, being about five per cent. of the type form.

No. 3 is a heavy shell, shorter and thicker than is the type, 1.10 by .40, with a thick double margin (.10), short, prominent central tooth and very narrow projecting frontal bar. The shell is white, mottled with very pale brown. Of this singular form I have two only, and they came from the northward of the type locatity.

Strophia cinerea may at once be distinguished from all other members of the genus by the thin margin, thickened slightly to the left, which is produced well forward, cylindrical form and peculiar color. No other Strophia, with which I am familiar, combines these characters in one species.

This species, being from an accessible locality, is quite common in collections, but in all of the cases where I have seen it labled it has erroneously borne the name of some of the older species which are from widely different localities.

The species has been known for many years, and we find it figured by Edmund A. Crouch, in his introduction to Lemarcke's Conchology, in 1827, plate XV, No. 2, as S. mumia! (See remarks regarding this on page 194 of Vol. I..)

HABITS AND DISTRIBUTION.

This singular and interesting Strophia occurs on Hog Island, along the shore of Middle Bay, which is on the south side of the key. The shells are found either on the ground or attached to the stems of low bushes not far above the ground. I traced them about a hundred yards along the bay in either direction; to the eastward they straggle out somewhat and grow into form No. 2, but to the westward terminate more abruptly, and do not occur far up the slope of the hill, which lies to the northward, excepting as stragglers, to be mentioned under head of the next sub-species.

31 STROPHIA CINEREA ROBUSTA Novo.

Robust Strophia.

Fig. 36, A, front view; B, side view of type.

DESCRIPTION.

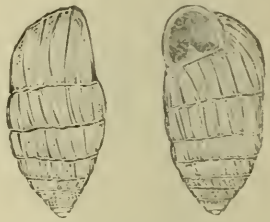
Sp. Ch. Size large. Form robust. Striations, present. Whirls, nine. Examined, seventy-five specimens.

Form of shell, conical; the upper whirl being the largest, and each successive whirl smaller in regular proportion to the fourth, where the shell slopes abruptly to a blunt point, forming an angle of sixty-eight degrees. The striations are not numerous, twenty-three to the first whirl, are rather prominent, quite regular, but not arranged in lines, nearly straight on the first four whirls, but are slightly inclined from right to left on the lower whirls; they are not furrowed but are smoothly rounded, and are about as wide as the interspaces between them.

Aperture, small and contracted at the entrance, measuring a little more within than at the margin. Lower tooth, quite prominent, about .04 high, less than twice as long as high; it is slightly elevated. The upper tooth is about as high as the lower, and extends backward around the column.

Margin, not produced forward as far as the diameter of the shell, is slightly inclined to the right, but not beyond the diameter of the shell, but the upper whirl bulges out from it on the left, about half the width of the aperture. The margin is not thickened, and the only lateral projection from it is on the left, and that is slight. The frontal bar is thin, but interrupts the striations.

FIG. 36.



Strophia cinerea robusta. A, front view, B, side view, of type.

Color of shell, externally, ashy brown, with the striations creamy white. Internally, dark-brown, creamy white on edge of margin and on teeth.

DIMENSIONS.

Size of type, 1.12 by .55. Largest specimen, 1.37 by .50: smallest, .97 by .30. Greatest diameter, .55: smallest, 30. Largest specimen, 1.25: shortest, .97.

OBSERVATIONS.

Individual variation is considerable, but is mainly toward a cylindrical form with a thickened margin through which this subspecies intergrades with typical S. cinerea, but through a small percentage of specimens, some of which have ten whirls. The margin of some specimens is also thickened. A decided form is as follows:

No. 1, smaller, 1.00 by .50. Whirls, still nine, but with the striations much more numerous, 26 to the first whirl. The upper tooth is not as prominent, and the color of the shell is paler.

The Robust Strophia may be distinguished at once in the type form from S cinerea by the nine instead of ten whirls, but there is, as stated, some gradations toward the parent stock.

HABITS AND DISTRIBUTION.

The Robust Strophia occurs on the north side of Hog Island among some dwarf palms that grow directly back of the beach ridge from a sandy soil. They are found clinging to the palm stems or leaves. The situation in which they are found is rather sheltered and the thickened shell has doubtlessly been evolved as a protection against the dryness and heat of the sand among which they live. The lack of any extended margin in both this and the parent stock would seem to indicate that the animal did not protrude itself as far from the shell as is usual in some other allied species.

The small form, No. 1, occured beneath palm leaves in groups of five or six, but neither form were abundant.

One of my chief reasons for considering this form as a sub-species only, is that I found an occasional specimen of typical S. cinerea, scattered along a path which led directly from the beach to Middle Bay, on the south side of the island, which is the home of the Cinerous Strophia. These shells are doubtlessly transported accidentally by persons who pass along the path, and thus as the colony of S. robusta receives an occasional recruit from the parent stock, direct intergrades occasionally occur.

32 STROPHIA CINEREA TRACTA Novo.

Mottled Strophia.

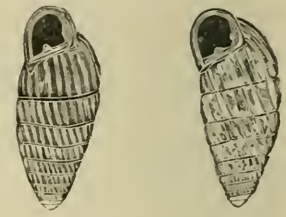
Fig. 37, A, front view of type.

DESCRIPTION.

Sp. Ch. Size, about medium. Shell, rather thin. Striations present. Whirls, ten. Examined, 300.

Form of shell, a pointed cylinder, the first whirl being the largest, then each successive whirl is a little smaller than that above it, to the fifth whirl, when the shell slopes to a rather acute point, forming an angle of fifty-eight degrees. The striations are rather numerous, twenty-six on the first whirl, are not prominent, are quite regular, but not arranged in lines. They are very smooth, not furrowed, and just about as wide as the interspaces between them.

FIG. 37.



A, Strophia cinerea tracta, front view of type. B, Strophia cinerea mutata, front view of type

Aperture, rather small, a little contracted at the entrance. Lower tooth small, about .03 high, not as long as high, and but slightly elevated, and is about central in position. The upper tooth is represented by a slight protuberance.

Margin, produced forward about as far as the diameter of the shell, is very slightly inclined to the right, a trifle beyond the diameter of the shell, is slightly thickened, measuring about .04, and while the posterior portion is produced backward into a blunt edge, it is not rolled over. The frontal bar is narrow, yet interrupts the striations, which are, however, slightly indicated within.

Color of shell, creamy white, beautifully mottled and flecked with yellowish brown and umber, the markings often crossing the striations. Within, deep umber brown, paler on the central tooth and fading rather abruptly into creamy white on the edge of the margin.

DIMENSIONS.

Size of type, 1.05 by .45. Largest specimen, 1.02 by .47; smallest, .75 by .37. Longest specimen, 1.25: shortest, .75. Greatest diameter, .47; smallest, .37.

OBSERVATIONS.

While the type form preserves its identity, and prevails in numbers, this is one of the most unsettled forms of Strophia that I have seen, as it has developed no less than five distinct forms, besides a small percentage of specimens showing complete gradations with typical S. cinerea. The forms are as follows:

No. 1. A long cylindrical form, with the first three whirls equal in diameter. Otherwise as in the type. Size 1.25 by .42.

No. 2. A color form nearly white, or with a few pale mottlings, otherwise as in the type.

No. 3. Form and size about as in the type, but very dark brown throughout, with white striations, which are more numerous, being twenty-five or more.

No. 4 is a small form, .75 by .37, with nine whirls only, but the margin is considerably thickened, and the color pale, with few or no fleckings. Nos. 1, 2, and 3 are not very common, constituting about three per cent. of the whole; of No. 4 there are about six per cent.

No. 5 is the most remarkable of all, being pure ivory white in color, externally and internally, with a thickened margin (about .07), and open aperture. Striations coarse and flattened, twenty to the first whirl. Both teeth are very prominent. Size, 1.00 by .37. This form recalls No. 3 of S. cinerea, but is smaller, heavier, and whiter. I have four shells only, and did not three of them show some gradations toward form No. 4, I should not hesitate to pronounce it a distinct species, as it is very far removed from the type. Further investigations in the neighborhood of the type location of S c. tracta may reveal a fixed locality for this shell.

HABITS AND DISTRIBUTION.

I found the Mottled Strophia quite common in a very restricted location on the borders of a field, that is situated nearly on the extreme eastern point of Hog Island. Here they were clinging to the grass and herbage, but I did not then observe any fixed location for the various forms. I should judge that the form was of quite recent origin, and has not yet become settled.

33 STROPHIA CINEREA MUTATA Novo.

Changing Strophia.

Fig. 37, B, front view.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, rather thick. Striations, present. Whirls, ten. Examined 100 specimens.

Form of shell, a pointed cylinder, with the first whirl the largest, then each successive whirl is slightly smaller than the one above it, as far as the fifth whirl, when the shell slopes gradually to a point, forming an angle of fifty-seven degrees. The striations are numerous, thirty on the first whirl, are small, slender, and regular, but not arranged in lines; they are slightly inclined from right to left, are not furrowed, but are smooth and rounded and a little more than one half as wide as the interspaces between them.

Aperture, rather small, and considerably contracted at the entrance. Lower tooth, not prominent, about .04 high, and about twice as long as high; it is not elevated, and is set back about once its length. The upper tooth is represented by a mere tubercle.

Margin produced forward nearly as far as the diameter of the shell, and is very slightly inclined to the right, a trifle beyond the diameter of the shell; it is thickened all around, hollowed out in the middle. and then projected backward into a sharp edge, which is not rolled over. The frontal bar is very thin and completely interrupts the striations.

Color of shell, deep umber brown, with most of the striations creamy white. Brown within, becoming creamy white on the edge of the margin and frontal bar.

DIMENSIONS.

Size of type, 1.15 by .40. Largest specimen, 1.14 by .50. smallest, .88 by .38. Greatest diameter, .50; smallest, .38. Longest specimen, 1.25; shortest, .88.

OBSERVATIONS.

Individual variation consists of gradual gradation into a smaller form, on one hand, with rather less number of striations, twenty-five on first whirl, and on the other, to a larger, thicker form with more numerous striations, thirty-seven on the first whirl, but there is no decided form among these.

No. 1. The only inclination to assume a form is, singularly enough, one which grades directly into typical S. cinerea. In fact, at one extremity of this form we have a cylindrical shell much like typical S. c. mutata, and at the other, shells which I confess I cannot distinguish in the smallest particular from typical S. cinerea.

The presence of this singular sub-species of S. cinerea on Long Key was a great surprise to me, the more so, as on Spruce Key, an island only about a half mile to the north of Long Key, I found two distinct species. not only different from anything on either Hog Island or on New Providence, but varying widely from one another.

Typical specimens of the Changing Strophia are very beautiful and so utterly different from S. cinerea that no one would suspect the relationship, but that, too, as stated, complete gradations occur between the two. I do not hesitate to affirm, however, that this species is of quite recent origin and that it has not had time to completely change. My reason for making this statement is mainly because I could not find any dead specimens of any forms on the ground, as is the case among old established species. This is also true in regard to the Mottled Strophia.

How long it takes to evolve a form of Strophia with characters so widely different as those exhibited by this one, it is difficult to say, with our present knowledge of the subject. I should think, however, that these mollusks, when placed under a widely different environment from that under which they had been living, would begin to change in two or three generations; but what the length of the life of a single individual is, and how long it is in coming to maturity is impossible to say. Judging, however, from the fact that in the winter it is so difficult to find a young Strophia with less than four whirls, that, with all my experience, I never saw a specimen with less than this number, it is probable that they grow quite rapidly, especially in summer, and probably acquire their full size in one year. Twenty years would mean much to a colony of Strophia, and would naturally produce many changes, while in a hundred years I should think that many species would grow old and become extinct.

Be these matters, which are, after all, somewhat speculative (but not, perhaps, as much as they seem) as they may, here we have in this Strophia a fine example of the changing of one species into another, and also very clearly shows how careful we, of to-day, must be in recording all the steps of change in order that future generations may benefit by our researches.

The typical Changing Strophia may be at once recognized by the dark color, white, and numerous striations.

HABITS AND DISTRIBUTION.

I found the Changing Strophia on March 29, 1893, clinging to shrubs along the rocky, northern shore of the western half of Long Key, an island that lies about a mile east of Hog Island. I traced the shells westward along the shore as far as the little bay on which the Marine Hospital stands and eastward to a sand beach about midway on the key. They were not found more than a few yards back from the water's edge. As the weather had been very dry all of the shells were fixed and hybernating.

34 STROPHIA ALBEA Novo.

Pink Strophia.

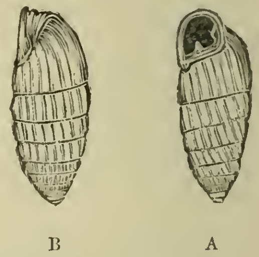
FIG. 38. A, front view; B, side view of type.

DESCRIPTION.

SP. CH. Size, rather small. Shell, quite thick and heavy. Striations, present. Whirls, nine. Examined forty specimens.

Form of shell, a pointed cylinder, the first whirl being the largest, then each successive whirl is a little smaller to the fourth whirl, then the shell slopes gradually to the top, forming an angle of forty-five degrees. The striations are numerous, twenty-five to the first whirl, are not prominent, but are very regular, appearing like little half cylinders laid against the shell; they are thus rounded, and are highly polished, without any furrows whatever, and are about one half as wide as the interspaces between them.

FIG. 38.



Strophia albea. A, front view, B, side view of type.

Aperture rather small, slightly contracted at entrance, and rather oval. Lower tooth prominent, about .04 high, and twice as long as high; not elevated, and set back about once its length from the frontal bar. Upper tooth quite well developed.

Margin produced forward about as far as the diameter of the shell, is thickened all around, measuring about .03, is grooved, and the posterior portion is produced into a deep edge which is not rolled bpckward. The frontal bar is comparatively thin, but completely interrupts the striations.

Color of shell, dark flesh color throughout boty, externally and internally, extending also over the striations, paler on the apex and margin, with no indications of fleckings or markings of any kind.

DIMENSIONS.

Size of type, 1.00 by .36. Largest specimen, 1.10 by .37: smallest, .81 by .36. Greatest diameter, .45; smallest, .36. Longest specimen, 1.10; shortest, .81.

OBSERVATIONS.

There is but little variation in this delicately-tinted Strophia, either in form, color, or size. The peculiar flesh-colored tint recalls at once the color of Strophia nuda, described in Vol. I, of these Contributions, but that shell was smooth and of quite a different form. I know of no other Strophia which exhibits this singular color.

HABITS AND DISTRIBUTION.

I found Strophia albea on the south side of Spruce Key (See fig. 40), clinging to the scanty shrubbery that grows from the naked rock on this nearly desolate little island. It evidently forms an example of a nearly extinct species for, although, in company with Mr. Curtiss I searched with great care, but three living specimens were obtained on the entire key, yet the ground was strewn with dead specimens, many of which showed marks of having been on the rocks for years.

35 **STROPHIA CORYI** Novo.

Cory's Strophia.

Fig. 39, A, front view, B, side view of type.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, quite heavy. Striations, present. Whirls, ten. Examined, 2,000 specimens.

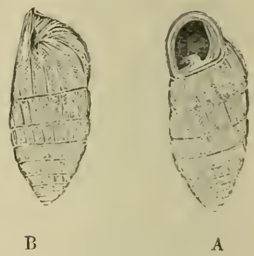
Form of shell, quite cylindrical, the first three whirls being about equal in diameter, the fourth is but little smaller, then the shell slopes to a rather blunt point, forming an angle of fifty-five degrees. The striations are not numerous, nineteen to the first whirl: they are not prominent, very regular, not furrowed, but rounded, narrow, are about half as wide as the interspaces between them, but are not arranged in lines, and very slightly inclined from right to left.

Aperture, quite small and rather contracted. Lower tooth, quite prominent, about .04 high, and about twice as long as high, nearly central in position, a little elevated, and set back about once its length. The upper tooth is about half as high as the central, is placed low, being but little above the top of the lower tooth.

Margin, produced forward as far as the diameter of the shell, is slightly inclined to the right, a trifle beyond the diameter of the shell. It is considerably thickened (.07), with the edge projected backward, and shapened, but not rolled downward. The frontal bar is quite well developed, and interrupts the striations, which are, however, slightly indicated within it.

Color of shell, externally, deep ashy brown, with the striations creamy white; internally, also brown, a little paler than on the outer surface, becoming creamy white on the tooth, margin and frontal bar.

FIG. 39.



Strophia coryi, A, front view, B, side view, of type.

DIMENSIONS.

Size of type, 1.00 by .40. Largest specimen, 1.12 by .42; smallest, .62 by .36. Greatest diameter, .45; smallest, 36. Largest specimen, 1.12; shortest, .62.

OBSERVATIONS.

The type form is very abundant, proportionately. and there is comparatively little variation that can be considered as purely individual. What little there is consists in a thinner or thicker margin. and slightly finer or coarser striations, but there are five distinct forms developed, which are as follows:

No. 1 is an elongated cylindrical form with the first four whirls equal in diameter, and a thinner margin. This form grades directly toward S. cinerea, and I have three specimens that are direct reversions toward that species. Size, 1.10 by 1.36.

No. 2. This is a singular form, nearly pure white in color, shorter, with nine whirls only, faintly yellowish within, and slightly tinted with brownish between the striations. Size, .97 by .47. This form recalls the white No. 3, which has been evolved from S. cinerea

No. 3 is a form with more numerous striations, twenty-four to the first whirl, and they are finer, the shell is darker, with dark umber blotches, which often cross the striations.

No. 4. A short form, with nine whirls, and, excepting this, is a miniature of the type. Size, .76 by .36.

No. 5. The smallest of all, with a very thin margin and with numerous striations, 30 to the first whirl, and the color, without and within, is much paler than in the type. Size, .65 by .37.

This last form is almost sub-specific, but there still remain too many specimens having intermediate characters, that bind them to other forms, to so consider it.

Form No. 1 is very rare, less than one per cent. of the whole. No. 2 is more common, about .10 per cent. of the whole. No. 3 is less common, about 1 per cent.; while Nos. 4 and 5 are more abundant, and form about five per cent. of the whole.

Cory's Strophia may be known by the heavy shell, thick margin, and peculiar brown color, with the contrasting creamy white striations.

I have named this species for Mr. Charles B. Cory, the well known ornithologist, who has exhibited considerable interest in West Indian shells, especially in the genus Strophia.

HABITS AND DISTRIBUTION.

Cory's Strophia is an abundant species on the extreme west end of New Providence, and is found clinging to bushes and herbage that grow along the bay. I traced it northward as far as the open grounds which lie about the single house that stands on this bay, and southward as far as the bushes extend, and eastward to the pine woods.

In regard to the locality occupied by the forms, I cannot speak with certainty, as I did not collect all of the specimens which were procured, and, in fact, had a few hours only in which to examine the locality, as we came to anchor in the bay for a short time, when we were bound for Andros.

One of the most singular things that I have to state regarding this Strophia, is the fact that I found five undoubted specimens on Spruce Key. Two of these only were living, all the rest were dead. Thus on this little key, which is only a few hundred yards long, live two species of Strophia.

We have seen that even among typical Strophia cinerea there is aninclination to evolve a white form (No. 3) and that this is quite like form No. 2, which is evolved by S. coryi. We also find that through form No. 1 of S. coryi, there is a decided tendency to a reversion towards S. cinerea, in fact, I have two specimens which are nearly or quite typical S. cinerea. I do not hesitate to affirm with these facts in view, showing so clearly the relationship of the two species, that S. coryi, as found on the west end of New Providence, is derived from S. cinerea. Now comes the question as to where the specimens of S. coryi which I found on Spruce Key came from. Has S. cinerea evolved two colonies of S. coryi, one for Spruce Key and one for the west end of New Providence?

The presence of a species of Strophia evolved from S. cinerea on the west end of New Providence is accounted for by supposing, quite reasonably, that the parent stock was transported there by the persons who settled on the plantation which is now there, the house of which I have spoken as being near the colony of Strophia coryi.

Now in regard to the specimens of S. coryi, found on Spruce Key, it seems more reasonable to suppose, that they also were evolved directly from the parent stock of S. cinerea, possibly through form No. 3, than to suppose that they were transported from the west end of New Providence, some twenty miles away. The shells from Hog Island could have reached Spruce Key through the agency of ocean currents, as will be seen by consulting the diagrammatic chart given in fig. 40.

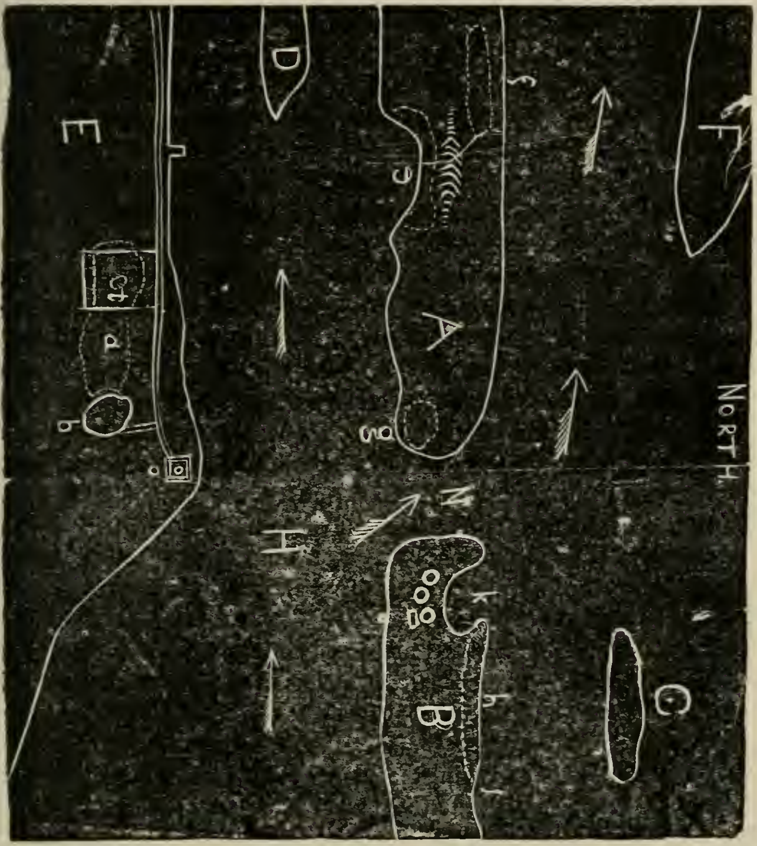
The scale of this chart is, roughly estimated, about two inches to the mile. A, is Hog Island, c, Middle Bay, the home of typical S. cinerea, C, is Spruce Key, but as the tide sets east and west through Nassau Harbor, in the ebb and flood, and north and south through the Narrows, N, between Hog Island and Long Island, B, a shell falling into the water at c, would quite possibly reach Spruce Key on the ebb tide.

In order that the reader may more fully comprehend the localities inhabited by the interesting species, sub-species and forms of Strophia, in the immediate neighborhood of Hog Island, I give the accompanying diagrammatic chart.

E, is a portion of New Providence, east of Spotter's Key. A, is the cemetery, and the locality bordered by the dotted lines, shows the range of S. curtissii, extending as far east as Waterloo, b. In the midst of these bounds, and in the cemetery, is the limited range of S. thorndikei, t.

Leaving the main island of New Providence, we cross to Spotter's Key, the eastern end of which is shown at D. This is the home of the

Fig. 40.



Diagrammatic Chart of localities inhabited by species of Strophia. A, Hog Island: B, Long Island: C, Spruce Key: D, Spotter's Key; E, a portion of New Providence: F, Salt Key: H, Nassau Harbor: N, Narrows: a, Strophia curtissii (the dotted lines indicate boundary limits): b, Waterloo: e, Middle Bay and Strophia cinerea: f, S. c. robusta: g, S. c. tracta; h, S. c. mutata: k, bay, near hospital buildings; i, sand beach; o, old magazine: t, Strophia thorndikei in the cemetery. The arrows indicate the course of the currents at flood tide.

long-toothed form of S. curtissii (No. 4).

Crossing another narrow channel, further north, we come to Hog Island, and at e, is Middle Bay, before mentioned, with S. cinerea living along its border, a widely different species from those which are found on the east end of New Providence.

Crossing the hill back of the bay, then a swampy valley, we ascend the hills which form the beach ridge and come to the scattered colony of S. c. robusta, f.

To the eastward on the southern side of the point of the island is the restricted colony of S. c. tracta, g.

Crossing the Narrows, N, which are about one fourth of a mile wide, we find the western end of Long Island, B.

[I will here remark, that probably owing to the great extent of the Bahamas, the names of some small keys are applied to more than one island. For example, we have this name "Long" applied to no less than three different keys: one near New Providence, as now given, one near Rum Key, and one in the Crooked Island Passage, further south.]

The buildings of the hospital occupy the western end of Long Island, and to the north of them is a little bay, k, east of this bay, around the point, the colony of S. c. mutata begins, and extends to a sand-beach, midway of the key at l, thus in the chart the western half only of Long Island is given. North of the western end of Long Island is the little rocky islet known as Spruce Key, on which two distinct species of Strophia live, or did live at the time of my visit, March 29th, 1893, namely, S albea and S. coryi (see c).

At F, directly north of Hog Island, is the desolate Salt Key, which I have not yet visited, and so cannot say whether it contains any species of Strophia or not.

It is still too early in the course of my investigations to even speculate intelligently as to the probable origin, time of distribution, etc., of the various forms of Strophia found in this locality, but this chart will, I trust, prove of interest in showing the direct localities in which the mollusks of which we are treating occur.

As an interesting item in the habits of S. coryi, I have to add that since the last sentence regarding that species was written one of the type specimens contained in a box on my table has left his fellows, crawled up the sides of the box about an inch and a half, and fixed itself there. Now this specimen was taken on the west end of New Providence on April 17th, 1893, and last night, that of December 14th, 1894, it has shown signs of life. This shell has, during these twenty months, been kept in a box, with others, and although some showed signs of life during the summer of 1893, they have, so far as I have observed, all remained quiet up to this time. Of course they have been kept in a warm room and in the drawer of a cabinet, where they have been but little disturbed. This incident is very instructive as showing the great length of time in which at least individuals, of this group of animals can live under adverse circumstances. See further remarks on this head under Strophia grayi and S. ritchiei.

36 STROPHIA RITCHIEI Novo.

Ritchie's Strophia.

FIG. 41. A, front; B, side view of type.

DESCRIPTION.

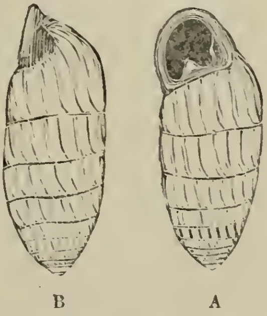
SP. CH. Size large. Shell, heavy. Striations, present. Whirls, ten. Examined, 1,000 specimens.

Form of shell, inclined to be cylindrical; the first two whirls being equal in size and the third is but little smaller, and from this the shell slopes to a rather rounded point, forming an angle of sixty-five degrees.

The striations are rather numerous, twenty-three to the first whirl, are regular, but not arranged in lines, about as wide as the interspaces between them, and although rounded and smooth, without furrows, are not polished.

Aperture, not very small, and open. Lower tooth large and prominent, about .08 high, and about as wide at the base as it is high, and nearly one and one half times as long as high. Its position is central, and it is set back a little less than its length. Upper tooth represented by a slight tubercle.

FIG. 41.



Strophia ritchiei, A, front; B, side view of type

Margin, produced forward nearly as far as the diameter of the shell, and is slightly inclined to the right, slightly beyond the diameter of the shell. It is thin and rounded, but not produced into any edge whatever. The frontal bar is extremely well developed, and so completely interrupts the striations that there is no trace of them within it.

Color of shell, dull white throughout, without markings of any kind. Within, flesh color, fading into white on the teeth and margin.

DIMENSIONS.

Size of type, 1.37 by .57. Largest specimen, 1.37 by .65, smallest, 1.10 by .46. Greatest diameter, .65; smallest .46. Longest specimen, 1.40; shortest, 1.10.

OBSERVATIONS.

The type form is very constant, pure individual variation being but slight. There is an inclination toward a more cylindrical form with the first three whirls equal, and some specimens show a slightly thickened margin, but as a rule, this is as in the type, and no thicker than the shell. The whirls vary in this form from ten to twelve. There are however, the following well-marked forms:

No 1. About the form and size of the type, but with more numerous striations, twenty-five to the first whirl. The margin is thinner, with the edge sharpened, and the aperture smaller and more contracted. The color is ashy brown, with the striations creamy white, and the color within is rather dark, purplish brown. In this form there are individuals with slightly coarser striations, 20 to 22 to the first whirl. These usually have a thickened margin and a more cylindrical form. This form is not very common, being about one per cent of the whole.

No. 2 is a small form, 1.10 by .47, but with ten whirls, and with only sixteen striations to the first whirl, and the first three whirls are equal in diameter. Otherwise as in the type.

No. 3. Cylindrical, with eleven whirls, the first three of which are equal in diameter. The striations are a little less numerous than in the type, but the margin is rounded, but not thickened. There is a slight individual tendency in this form to assume, with fewer striations, the thin sharpened margin seen in the next species, S. grayi, but I can find no fewer than eighteen striations in any specimen, therefore it is the extreme form is not typical S. grayi. These are about one half per cent of the whole of this form.

No. 4 is a remarkable form typically and, in fact, an incipient species, but with two many gradations yet to permit a consistent naming. The general form is about that of typical S. ritchiei, but the aperture is wider and decidedly more open, but above all the striations are very numerous, thirty-four to the first whirl, and although they are narrow, they are so crowded as to be wider than the interspaces between them. The color is dull white, faintly tinted with flesh color within.

This Strophia may be readily known by the large size, white color, projecting and thin margin, with its prominent frontal bar. There is a superficial resemblance to S. alba, but alba has a wider, more flaring, margin, with the edge rolled over and sharpened, and with the frontal bar not at all well developed. The central tooth is also small in alba, and set back from the bar about twice its width. From S. grayi it may be distinguished as given under that heading.

I have named this fine, large Strophia for Mr. John Ritchie, Jr., of Boston, the well known conchologist and scientist, who, from the beginning, has exhibited the utmost interest in my work upon this genus.

HABITS AND DISTRIBUTION.

Highburn Key lies to the eastward of what is known as the Middle Ground, an expanse of shallow water about thirty miles wide that stretches out toward the Atlantic from New Providence. The key is partly divided in two by bays which break into the land north and south ,hence forms a rude letter H, with a rather wide cross bar. Both the eastern and western arm of the key are made up of hills, but those to the eastward are higher and a little wider, than those to the westward.

We entered the bay on the south of the key and landed near its head. Almost immediately upon looking about I saw specimens of Ritchie's Strophia. They were clinging to the stems of bushes and here occurred the typical form. I traced it back along the eastern hills northward for about a mile, a short distance beyond the ruins of the only building that stands on the key, and southward to the southern point of this division of the key, but at this point the brown form, No. 1, was more prevalent, growing in the shade of the thicker shrubbery. Westward it spreads to the front of the hills of that division of the key but is not found on them. Thus it has quite an extended range, occupying about a half of a square mile, but it is nowhere numerous, as compared with many other species of the genus.

One of the most striking features of this species appears to be its powers of endurance. I have now a number of living specimens that were collected on Highburn Key on April 8th, 1893, that have been kept in a box in my cabinet. Last summer they gave me some trouble by wandering about over the other boxes, but have not attempted to move much since, but today, December 15th, I pierced the shell of one and found the animal, which is a pale horn color, lively, and it immediately shrunk back a whirl in from the broken portion of the shell, but did not form the usual partition. Although I put both this specimen and that of Cory's Strophia, of which I have spoken, in water, yet the animals have not as yet ventured out of their shells.

37 STROPHIA GRAYI Novo.

Gray's Strophia.

Fig. 42, A, front, B. side view, of type.

DESCRIPTION.

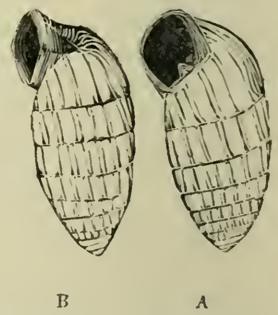
Sp. Ch. Size, rather large. Shell, thick and heavy. Striations present. Whirls, eleven. Examined 700 specimens.

Form of shell, cylindrical, the first three whirls being about equal in diameter, the fourth is a little smaller: then the shell slopes to a blunt point, forming an angle of sixty-nine degrees.

The striations are not numerous, sixteen to the first whirl, are rather prominent, not very regular, and not arranged in lines: they are not furrowed, are smoothly rounded, and slightly polished: the interspaces between them are wider than they are, and furrowed with longitudinal lines of growth.

Aperture small, with the corners decidedly angular, especially below, slightly contracted at the entrance. Lower tooth quite prominent, .04 high, as wide as high, and twice as long as high: it is set very far back, .12 from the frontal bar, is not at all elevated, and is about central in position. Upper tooth absent.

Fig. 42.



Strophia grayi. A, front view, B, side view of type.

Margin produced forward beyond the diameter of the shell, is inclined to the right beyond the diameter of the shell; is thinner than the shell behind it, and the edge is sharpened without being rolled over, but is much roughened on the sides by lines of growth. The frontal bar is developed to a remarkable degree, protruding far beyond the shell (.08), as far, in fact, as the rest of the margin, and has three or four lines of growth between its edge (which is thin, sharpened as in the other portions of the margin) and the striations.

Color of shell, throughout, externally, dull white; internally, deep brown, fading into white on the tooth and margin beyond it.

DIMENSIONS.

Size of type, 1.25 by .55. Largest specimen, 1.40 by .67; smallest, 1.05 by .47. Longest specimen, 1.40; shortest, 1.05. Greatest diameter, .67; smallest, .47.

OBSERVATIONS.

Individual variation is mainly in the direction of a form with fewer striations, sometimes as few as thirteen only are found. Some individuals have the upper tooth developed, then there are more striations, and the margin is thicker, with the edge smoothed and not sharpened as in the type. I regard these specimens as decided reversions toward S. ritchiei which is undoubtedly the parent stock of this species. In concluding that S. ritchiei is the older species I have been guided not only by the fact that S. grayi shows considerable reversion towards that species, but also because S. grayi appears quite unsettled, for it has not only produced three well marked forms, but two other forms which I must regard as sub-species. The three forms are as follows:

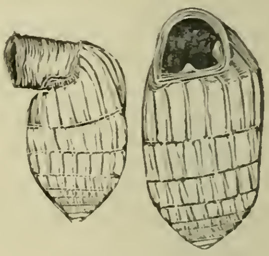
No. 1, shorter and proportionately thicker than in the type (1.10 by .57); whirls, ten, the first three of which are about equal in diameter. Margin not produced forward as far as the diameter of the shell, and with the edges slightly rounded. Striations, twenty to the first whirl. Tooth and color, as in the type, but the upper tooth is present, but small. Variations are toward producing a sub-form with a thickened margin, but in some cases the margin is produced forward with the edge upward. These are about one per cent. of this form.

No. 2. Also short, but more slender, 1.06 by .50. Whirls, ten. Margin not produced forward any farther than the diameter of the shell. Striations, eighteen to the first whirl. The variation in one direction is toward a sub-form, with a less number of less distinct striations and a more cylindrical shell, and on the other hand, toward a greater number of more prominent striations, but with the form typical. There are rather more than two per cent. of this form.

No. 3. A remarkable form, with a short, thick cylindrical shell, which, from the fourth whirl, slopes to a very blunt point, forming an angle of eighty-five degrees. Margin, teeth and color about as in form No. 1, excepting that the upper tooth is well developed. Striations, nineteen to the first whirl. See fig. 43, A. I have seen ten or twelve only of this remarkable form.

Strophia grayi may be at once distinguished in the type form from S. ritchiei by the coarser, fewer striations and above all by the projecting margin with its sharpened edge, which character will separate it also from all other Strophias which I have examined. In fact, in Strophia grayi this margin appears to have reached the maximum development and seems to be its strongest character. A specimen of form No 1 which has had the margin broken, has replaced it with one that measures .30 in length and which has the frontal bar projecting about .20 beyond the shell. See 43, B. It is a significant fact, that the central tooth, being no longer necessary with such a length of margin, has become nearly absorbed.

FIG. 43.



A, Form No 3, Strophia grayi. B, Deformed specimen of S. grayi.

There appears to be a great tendency among injured shells of this species to replace the broken parts with deformites, but as I intend to figure those peculiarities later, among others of other species, I will not enlarge upon them here.

I have named this species from Mr. Arthur F. Gray, of Boston, the well-known and accomplished conchologist.

HABITS AND DISTRIBUTION.

In my account of S. ritchiei, I have said that there is a range of hills along the eastern side of Highburn Key. At the Northern end of the key these hills terminate in a conical peak which is about a hundred feet high. The sides of this hill are not only very steep but but are composed of crumbling lime rock, and were it not for the fact that it is covered everywhere with a dense growth of trees it would be almost impossible to climb it.

This hill is the home of typical S. grayi and here they are very abundant, living by preference on the stems of a kind of wild fig tree which has white bark.

Form No. 1 occurs at the base of the hill on the western side, while No. 2 occurs on the flats near the northern bay, and the singular No. 3 in the vicinity of the ruins of the house on the top of the hill, midway of the eastern arm of the key. The range of S. grayi may be thus given, as from the ruin, of which I speak, northward along the esatren border of the range of hills about a mile to the northern hill, when it extends all over this hill, thence westward across the plain, passing through the forms No. 1 and 2, to the bluffs on the western borders of the key, thence northward about one half the length of the key, to a deep gorge that makes in from the sea, just north of a point of cliffs. Then, excepting along the very edge of the cliffs, the species is replaced by the small sub-species described.

38 STROPHIA GRAYI GIGANTEA Novo.

Gigantic Strophia.

FIG. 44, A, front view.

DESCRIPTION.

SP. CH. Size, very large. Shell, heavy. Striations, present. Whirls, eleven. Examined fifty specimens.

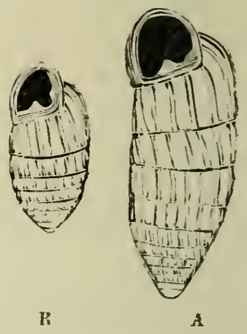
Form of shell, cylindrical, the first, second and third whirls are about equal in diameter, the fourth is but little smaller, then the shell slopes gradually to a rather acute point, forming an angle of sixty-five degrees. The striations are few, twenty-three to the first whirl. Are not prominent, quite regular, and arranged in lines: they are slightly inclined from right to left, are rather narrow, hence the interspaces between them are wider than they: they are not furrowed, but are smoothly rounded, but not polished.

Aperture, quite small, inclined to be rounded, and is slightly contracted at the entrance. The lower tooth is quite prominent. .04 high, and is about twice as long as high. It is set back about once its length, but is rather depressed below the level of the frontal bar, and is about central in position. The upper tooth is slightly developed, and is about on a level with the middle of the central tooth.

Margin produced forward about as far as the diameter of the shell, but not beyond it: it is thin, being about as thick as the shell behind it, and the edge is smooth and rounded, but is not produced into a thin edge. The frontal bar is well developed, and completely interrupts the striations.

Color of shell, externally, dull white throughout: internally, pale brown, fading into white on the tooth and margin.

FIG. 44.



A, Strophia grayi gigantea. B, Strophia grayi pumilia.

DIMENSIONS.

Size of type, 1.56 by .55. Largest specimen, 1.67 by .60: smallest, 1.40 by .55. Greatest diameter, .70; smallest, .55. Longest specimen, 1.67; shortest, 1.40.

OBSERVATIONS.

Individual variation in this sub-species is considerable, the inclination being toward an even larger form, with coarser and fewer striations. This large form has twelve whirls and the largest specimen, of which the dimensions are given above, has thirteen whirls, thus exceeding the maximum number of any species hitherto examined by me. Aside from these variations there is a distinct form, as follows.

No. 1. Similar to the type in general form and size, but with narrower striations, which are less prominent, and the color is dull, ashy brown, with the striations creamy white, also darker brown internally.

HABITS AND DISTRIBUTION.

The Gigantic Strophia occurs in the thickets which grow along the hillside to the southward of the ruin of which I have spoken as being on the eastern hill, midway of the key. They are very solitary in habit, each usually living apart from its fellows.

The dark form I found in a little valley on the hillside near the landing-place, which is near the head of the southern bay, under the thick shade of some dense foliage.

39 STROPHIA GRAYI PUMILIA Novo.

Short Strophia.

FIG. 44. B, front view of type.

DESCRIPTION.

SP. CH. Size, rather small. Shell, heavy. Striations, present. Whirls, nine. Examined, fifty specimens.

Form of shell, a short cylinder, with the first three whirls about equal in diameter, the fourth is somewhat smaller, then the shell slopes quickly to an abrupt point, forming an angle of seventy-five degrees. The striations are few, eighteen to the first whirl, not prominent, rather regular, but not arranged in lines; they are nearly straight, especially on the two upper whirls, but on the remainder of the shell are slightly inclined from right to left; they are narrow, being only about half as wide as the interspaces between them, are rounded, and although not furrowed, are not particularly smooth.

Aperture, rather small, inclined to be rounded and open. Lower tooth rather prominent, about .03 high, and about twice as long as high, is a little elevated, is set back about once its length from the frontal bar, and is about central in position. Upper tooth present, but very small and elevated above the top of the lower.

Margin, not produced forward quite as far as the diameter of the shell, and although placed a little to the right of the center of the shell is not inclined to the right. The edge is rounded, and considerably thicker than the shell behind it, but is not rolled backward. The frontal bar is developed well enough to completely interrupt the striations, but projects very slightly beyond them.

Color, dull white throughout, externally: internally, pale brown becoming white on the teeth and margin.

DIMENSIONS.

Size of type, .90 by .42. Largest specimen, 1.08 by .45; smallest. .95 by .37. Greatest diameter, .50; smallest .37. Longest specimen, 1.03; shortest, .85.

OBSERVATIONS.

Variation lies between a margin as thin as in typical S. grayi, sometimes protruded, frontal bar and all, and a thickened margin, with a very low frontal bar.

As will be seen this sub-species, as well as S. g. gigantea. possesses some of the characters of both S. grayi and S. ritchiei but as the specimens which show intergrading links are between these two forms and S. grayi, this fact, taken in connection with the circumstances under which they are found, points clearly to the conclusion that they are derived directly from S. grayi.

HABITS AND DISTRIBUTION.

I found about fifty of this singular little Strophia clinging to the stems of two or three small trees that grew just south of the deep gorge, that limits the southward range of S. grayi, as given under that species. The space in which they occurred could not have exceeded a hundred square feet. No specimens of S. grayi, were, however, found very near them, and this little colony had become isolated, and from some cause had advanced far toward forming a species.

40 STROPHIA EBURNIA Novo.

Ivory Strophia.

FIG. 45, A, front view, B, side view of type.

DESCRIPTION.

SP. CH. Size rather small. Shell, quite thick. Striations, present. Whirls, ten. Examined, 100 specimens.

Form of shell, an elongated cylinder with the first three whirls about equal in diameter, the fourth is but little smaller, then the shell slopes to a rather acute point, forming an angle of sixty-five degrees.

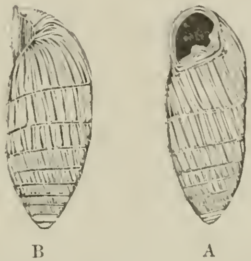
The striations are quite numerous, twenty-five to the first whirl, are not prominent, quite regular, but not arranged in lines. All are considerably inclined from right to left, they are smoothly rounded and polished, and a little more than one half as wide as the interspaces between them.

Aperture, rather small, but quite open, and not at all contracted at the entrance. Lower tooth, rather prominent, a little elevated, about .03 high, and about three times as long as high. There is a slight tubercle on the left side between it and the upper tooth. The upper tooth is also well developed, and extends further forward than is usual, while the space between it and the tubercle is inclined to be filled in.

Margin, not produced as far forward as the diameter of the shell, and is placed more nearly central in the shell than is usual, and does not incline at all to the right, it is a little thickened, with the edges beveled and produced backward into a blunt edge. The frontal bar is not well developed, but completely interrupts the striations.

Color of shell, externally, ivory white, with a faint bluish tinge, as is plainly noticeable in the sutures between the whirls: within it is rather pale brown, which color extends over the teeth very nearly to the edge of the margin before fading into creamy white.

FIG. 45.



Strophia eburnia, A, front view, B, side view, of type.

DIMENSIONS.

Size of type, 1.15 by .45. Largest specimen, 1.32 by .47: smallest, 1.00 by .45. Greatest diameter, .48; smallest, .42. Longest specimen, 1.47; shortest, 1.03.

OBSERVATIONS.

Individual variation in this well-marked and peculiar species is in two ways, as follows:

One is towards a larger, more pointed form and another towards one which is shorter. The tubercle on the left side of the central tooth is peculiar and marks a tendency which in some specimens becomes very prominent and forms a decided double tooth. With this double tooth, which appears in about one half the specimens examined, we find a decided tendency to fill in the space between the upper and lower teeth.

When the tooth is not double it is elongated to a great extent, sometimes more than three times its length. With this elongated central tooth we also find that the upper tooth is extended forward often to the edge of the margin; a character, which, excepting in the extinct species, S. elongata, next described, I have observed in no other Strophia. Thus it will be seen that a species of Strophia living, as will be seen under the head of Habits it does live, in an exposed situation, on a small, wind-swept key, has in order to maintain a better control of its shell, not only, in some cases, assumed the elongated central tooth, which we find in species which live in similar situations, but which in other individuals accomplished the same purpose by assuming a double central tooth and has further closed the aperture by filling in the space between the central and the upper teeth. Again, in other individuals, for the same purpose the upper tooth is projected forward.

Another variation is in color. I have a single specimen of ivory white, without and within. This specimen has the double tooth quite well indicated, with the space between it and the upper tooth partly filled. One or two specimens show faint indications of fleckings between the striations.

HABITS AND DISTRIBUTION.

On page 13, of the present volume, I have given a diagram of the singular islet which I have named U Key. I mentioned in the article which accompanied this diagram that the eastern and western sides, or arms, of the U, were hilly, and that on the southern portion of the key the land was low and sandy. This sandy tract was covered with a spare growth of palms and had been the home of the interesting Ivory Strophia.

I say "had been" for from the western side of the sandy land, which I have indicated by a number of †, to the eastern border of it, I did not find a living specimen of a Strophia, although the ground was strewn with hundreds of dead specimens in all stages of decay, with now and then a perfect individual, but all were bleached perfectly white by the sun. On nearing the little hill on the eastern border of the sand, I began to find fresher specimens, but not until I came to the rocks of the hill itself, did I discover a living shell. Then I collected twelve, which were all clinging to some low bushes, but although I spent several hours in two days and examined every branch and twig of every bush in the vicinity, and searched all other portions of the key, I could not discover another living specimen of Strophia eburnia.

I was therefore thoroughly satisfied that I had chanced upon a second species, S. albea being the other, which was on the verge of extinction. The large number of dead shells, some of which showed marks of having been lying on the sand for many years, proved most clearly that individuals of this species were abundant once, and that the last stronghold of the species was the bushes on the borders of the little hill. The species had fought bravely for an existence against some foe which it could not conquer, and had gradually succumbed, leaving the battle-field strewn with its dead, while I was just in time to gather the handful of survivors, among which, I ought to mention, was a single young specimen.

Now what was the foe that proved so fatal to this species? From a long and careful consideration of the subject. aided by many facts which I cannot now mention, I unhesitatingly answer, the sand, on which the dead shells now lie strewn. Once, in all probability, this tract was naked rock, covered with palms or bushes. Then the Ivory Strophia found a congenial home there, for during wet weather it would pass from bush to bush, or from palm to palm, and thus joining its fellows, on neighboring bushes, by mutual cross-fertilization increase the race. Changing ocean currents formed a sand beach outside the rocks and this sand was carried by the winds over the narrow neck of land, in time completetly covering the rocks. Now, even in wet weather, the Strophias cannot well travel on sand, thus, when each bush or palm was surrounded, the mollusks on it became as much isolated as would be a ship-wrecked mariner when cast upon a lonely island, miles from other land. Then two things occurred, gradually the wind, especially during hurricanes, threw the Strophias off their feeding grounds on to the sands, from which they could not escape, hence they perished. The decay of the race was probably hastened by the fact that when a few were left, they became, in time, too closely related to perfect fertilization, thus after a time few or no young appeared. Hence I found only a single young specimen among a dozen adults.

How long it took for the sand to cover the neck of land is impossible to say, but, after the beach was formed, it was probably not long in being covered; thus it was that I found so many dead shells on the surface.

Why the species did not retreat to the rocks on either side can be explained by supposing that the shrubbery there was not of the proper kind for their sustenance, for it is a fact that the species of Strophia live by preference upon particular trees, shrubs or herbiage, as I have shown in several cases, and seen in several others.

One other fact remains to be mentioned before closing this brief history of the Ivory Strophia, and that is that I discovered a single specimen of what I must at present consider as this species (although it is too stout, lacks the upper tooth, and differs somewhat otherwise to be quite typical) on a key that lies about a half mile north of U Key, which I have called Pimlico Key, on account of the abundance of the Pimlico, or Audobon's Shearwater which inhabit it. I did not find a single specimen, besides this, of any form of Strophia, either living or dead, on the key, therefore conclude that this must have been drifted there by ocean currents.

41 STROPHIA ELONGATA Novo.

Long Strophia.

FIG. 46, A, front view. B, side view of type.

DESCRIPTION.

SP. CH. Size, rather large. Shell, thick and heavy. Striations, present. Whirls, eleven. Examined twenty-five specimens.

Form of shell, a long cylinder, with the first three whirls about equal in diameter, the fourth is but little smaller, then the shell slopes to an acute point, forming an angle of sixty-nine degrees. The striations are numerous, thirty-three to the first whirl, are not prominent, are narrow, and although numerous, no wider than the interspaces between them: they are inclined to be angular rather than rounded, are regular, but not arranged in lines, and are very slightly inclined from right to left.

Aperture, quite small, somewhat elongated, but rather open. Lower tooth very large, prominent and double, having an elevation to the left, and also a small tubercle to the right. This tooth is about .11 high, and about as wide and long as high. The upper tooth is small and about on a level with the top of the lower tooth.

Margin, produced forward nearly as far as the diameter of the shell, is rather central in position in the shell, and is slightly inclined to the right, but not beyond the diameter of the shell. It is thickened, about .05, and is beveled. The frontal bar is well developed, and is considerably thickened, completely interrupting the striations.

Color of shell, as far as can be made out from dead specimens, was white, externally, brownish within.

DIMENSIONS.

Size of type, 1.33 by .50. Largest specimen, 1.45 by .52; smallest, 1.27 by .45. Greatest diameter, .55: smallest, .45. Longest specimen, 1.45; shortest, 1.27.

OBSERVATIONS.

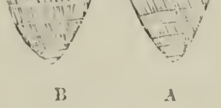
Individual variation is toward a form that is more elongated, but still with eleven whirls, otherwise there is but little variation from the type. The large double central tooth of this species shows the relationship of this shell with S. eburnia, and, as it inhabits a key only about a mile distant, is beyond doubt the ancestor of that species.

HABITS AND DISTRIBUTION.

The Long Strophia occurred on a little key that lies about a mile north of U Key, at Allen's Harbor. I say occurred, for as far as we could ascertain by the most careful search, no living specimen is now to be found on the key, nor were were there any shells seen that appeared to have been very recently alive, but some show great age.

In an article, earlier in this volume, I have spoken of this key as having been the resort of the Lucayan Indians, and the conch shells of which I have spoken as having been opened by them, do not appear to be older than many of the specimens of Strophia elongata which lie scattered near them, hence we may conclude that this Strophia was living on the key when it was inhabited by the Indians. Possibly then the key was partly cleared of shrubbery, and after the departure of the Indians the thick growth, which now covers it, sprung up causing changes.

FIG. 46.



Strophia elongata. A, front B side view.

which were unfavorable to the Strophias, so they gradually died.

The remains were scattered quite regularly over the entire surface of the key, but, judging from specimens examined, they remained alive longest in the southern portion of the islet near the site of the Indian well, of which I have spoken.

42 **STROPHIA NEGLECTA** Novo.

Neglected Strophia.

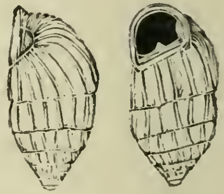
FIG. 47, A, front view, B, side view of type.

DESCRIPTION.

SP. CH. Size medium. Shell, heavy. Striations, present. Whirls, nine.

Form of shell, rather oval, the first and second whirls being about equal in diameter. Then the shell slopes to a quite acute point, forming an angle of sixty-two degrees. The striations are few, fifteen to the first whirl, are very irregular, and not arranged in lines; those on the first whirl are many of them straight, but some are inclined from right to left; on the remaining whirls all are inclined, but some more than others, hence the striations present a peculiarly broken appearance; they are partly rounded, and although not furrowed, are broken and roughened in many places. They are narrow, not one half as wide as the interspaces between them.

FIG. 47.



Strophia neglecta. A, front view, B, side view, of type.

Aperture, not large, well arched above, and very slightly contracted at the entrance. Lower tooth, not very prominent, about .02 high, and about twice as long as high, width about equaling height; its position is about central, and slightly elevated. Upper tooth, placed quite high, considerably above the top of the lower tooth, is about one half as large as the lower.

Margin not produced forward quite as far as the diameter of the shell, is placed a little to the right of the center of the shell, and is very slightly inclined to the right; it is about twice as thick as the shell behind it, with the edge beveled and produced into a sharpened edge, which is, however, not rolled backward. The frontal bar is not well developed, not protruding beyond the striations, but completely interrupts them.

Color of shell, externally, ashy throughout, striations and all; internally, pale brown, becoming paler on teeth and margin.

DIMENSIONS.

Size of type, .92 by .45. Largest specimen, 1.05 by .50: smallest, .77 by .40. Greatest diameter, .50; smallest, .40. Longest specimen, 1.05; shortest, .77.

OBSERVATIONS.

Individual variation is toward a larger shell, with a thicker margin and with more striations, but not in any marked degree, on one hand, and toward a smaller form with a thinner margin and fewer striations.

This singular Strophia may be at once distinguished from any other by the peculiar ashy color, which in many specimens has a decidedly bluish cast, but more particularly by the wide apart, irregular striations, which, being inclined in different degrees, give the shell a singularly rough appearance, in-so-much so, that I know of no shell of this genus that approaches it in these particulars.

This species often occurs in collections labeleld as S. glans, but the glans of Kuster, as figured by him, as cited, under that head, further on in this monograph, is a white shell, with rather numerous, quite regular, striations, and does not at all resemble S. neglecta, excepting possibly in being of an oval form.

HABITS AND DISTRIBUTION.

In January, 1884, I found the Neglected Strophia on the borders of a deserted plantation on New Providence about a mile west of Fort Charlotte. Here they were abundant, clinging to the bushes, and were also on the fence that divided the plantation from the road that runs from Nassau to the westward. All gathered in this locality at that time were typical.

Nine years later, in March, 1893, I visited the spot and found the plantation recultivated. The bushes were uprooted, and the entire locality changed into sisal hemp fields. On these plants, a species of agava, I found Strophias in considerable numbers, but few among them were typical S. neglecta, most of them being intergrades between the Neglected Strophia and the Agava Strophia, or were the S. neglecta agava itself. Increditable as it may seem, after the most careful examination of specimens and the ground in the vicinity of the old type locality, I am forced to the conclusion that, as a species with a distinct locality, Strophia neglecta no longer exists. In nine years these shells, placed under different environment by the clearing of the fields, and planting of sisal hemp. have produced a form which I must consider, at least, as being sub-specific. To be sure, a few typical specimens do exist, but they are scattering, and I will venture to predict that in ten more years, it will be exceedingly difficult, if not impossible, to find a typical Strophia neglecta anywhere alive. In searching for typical S. neglecta on my last visit, I was very much surprised that I could not find it, seeing clearly that the specimens I was collecting were far from typical, but I was even more astonished when I came to compare the newly-gathered shells with those that had been lying in my cabinet for nine years, to note the difference. This difference I have tried to express both in the figures of the parent stock and in those of the sub-species, and in the description of them, but one must see the two forms together to thoroughly comprehend how marked these differences are.

I wish to be distinctly understood to say that I have never found a single example of what I consider as Strophia neglecta a hundred yards from the type locality, nor one of the sub-species elsewhere than in the sisal fields to the west of Nassau, or along the road that borders them, as given under the head of the sub-species.

43 STROPHIA NEGLECTA AGAVA Novo.

Agava Strophia.

Fig. 48, A, front, B, side view, of type.

DESCRIPTION.

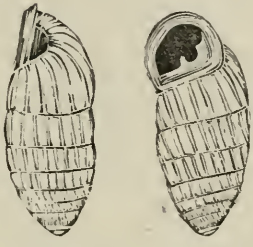
Sp. Ch. Size, rather above medium. Shell, thick and heavy. Whirls, ten. Striations, present. Examined 500 specimens.

Form of shell, a pointed cylinder, with the first two whirls about equal in diameter, then the shell slopes gradually to a rather acute point, forming an angle of sixty-three degrees. Striations, rather numerous, twenty-four to the first whirl, they are rather narrow, not as wide as the interspaces, quite irregular, smoothly rounded, and inclined to be polished. They are slightly inclined from right to left, and well arranged in lines.

Aperture, rather large, quite open, and not contracted at the entrance. Lower tooth, quite prominent, about .05 high, and not quite twice as long as high, slightly elevated, and set back about once its length from the frontal bar. Upper tooth well developed, about half as large as the lower and is placed a little above the top of the lower.

Margin, produced forward about as far as the diameter of the shell, is placed quite nearly in the middle of the shell, and is only slightly inclined to the right. It is about twice as thick as the shell, is beautifully beveled, and projected backward into a blunt edge. The frontal bar is slightly developed, and the striations are indicated within it.

Fig. 48.



Strophia neglecta agava. A, front, B, side view of type.

Color of shell, externally, yellowish ash, striations and all; internally, brownish, becoming paler on the teeth and margin.

DIMENSIONS.

Size of type, 1.21 by .47. Largest specimen, 1.35 by .50; smallest, .93 by .42. Greatest diameter, .50; smallest, .42. Longest specimen, 1.35; shortest, .93.

OBSERVATIONS.

Individual variation in this sub-species is toward a smaller form, with coarser, more widely-apart striations, thus passing through a small percentage of specimens into typical S. neglecta, and on the other hand, into a larger, heavier form, with striations about as in the type.

This well-marked sub-species differs from typical neglecta in the larger size, thicker margin, and more numerous striations. From all other Strophias it may be known by the acute apex and singular color.

HABITS AND DISTRIBUTION.

In March, 1893, I found the Agava Strophia common throughout the sisal fields to the westward of Nassau as far as the fields extend, and I traced it for about eight miles westward and about a mile back from the coast. The form becomes more typical as it recedes from the type location of S. neglecta, and we found some very fine, large specimens about a mile south of this point.

This shell, which has beyond all doubt. been developed into what is nearly a well-established species through the clearing of the fields, is frequently found clinging to the huge leaves of the sisal plants, but it is also found on herbage and shrubbery which grows in the fields.

44 STROPHIA CARLOTTA Novo.

Ft. Charlotte Strophia.

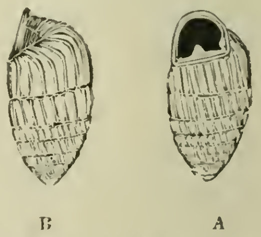
Fig. 49, A, front, B, side view, of type.

DESCRIPTION.

SP. CH. Size, small. Shell, rather thin. Striations, present. Whirls, nine. Examined 1,000 specimens.

Form of shell, oval, with the first whirl the largest, the second is but little smaller, then the shell slopes gradually to a rather blunt point, forming an angle of seventy degrees. The striations are quite numerous, twenty-four on the first whirl, they are a little narrower than the interspaces between them, are beautifully rounded being about one half as high as wide and considerably polished. They are straight and slightly inclined from right to left.

FIG. 49.



Strophia carlotta. A, front B, side view, of type.

Aperture, placed near the center of the shell, is not large, arched, short, about as high as wide and not much contracted at the entrance. Lower tooth, not prominent, .03 high, narrow, not as wide at high and about twice as long as high, is set back about once its length from the frontal bar, and is not elevated. The upper is about one half as large, is placed low, not once its width from the floor of the cavity.

Margin, not produced forward quite as far as the diameter of the shell, is a little thicker than the shell behind it, is slightly beveled into a blunt edge, but this is not produced backward. The frontal bar is not very well developed, although it completely crosses the aperture, yet the striations are indicated within it.

Color of shell, reddish brown, externally, with the striations paler. Pale brown internally, becoming paler on the teeth and magrin.

DIMENSIONS.

Size of type, .85 by .40. Largest specimen, 1.00 by .43; smallest, .72 by .35. Longest specimen, 1.00; shortest, .72. Greatest diameter, .43; smallest, .35.

OBSERVATIONS.

Individual variation is toward a form with a thickened margin, that is beveled and grooved, in this respect resembling the margin of a fossil form (S. agassizi) recently described by Dall (Bulletin Mus. Comp. Zool. Vol. XXV, 1894, p. 122) as coming from the aeolian limestone, of the top of the quarry, about a mile east of Ft. Charlotte. While S. agassizi may be the remote ancestor of this species, it is probable that it has passed through several species since then. S agassizi has no striations, but I have found a large fossil Strophia scattered through the aeolian limestone of the surface of New Providence, in the neighborhood of Nassau, which is more probably the immediate ancestor of S. carlotta. Individual variation is also toward producing a form with coarser, more widely-apart, striations. Individuals of this kind were doubtless the origin of S. neglecta, for S. neglecta, although such a strongly marked species, has some characters in common with S. carlotta, such as general form, wide, low aperture, nine whirls, and the peculiar form of the striations, which in S. carlotta are, as nearly as possible, half pillars, recalling at once the beautifully-polished striations of S. albea from Spruce Key. Those striations appear of the same general form in neglecta and through it in S. n. agava, but they are broken and somewhat roughened in S. neglecta. They have, however, in a measure, regained their original form in S. n. agava. Besides these individual variations, we find two well-marked forms.

No. 1. A dwarf form, the smallest given in Dimensions. Whirls, eight, and striations, eighteen to the first whirl, otherwise the same as in the type.

No. 2 is larger, with nine whirls, thicker margin, and with a heavier shell. This form in some respects resembles S. n. agava and was it not for the fact that it differs in color, and has a lower, wider aperture, resembling the type S. carlotta, and that S. n. agava intergrades directly with S. neglecta, it might be supposed to be the direct origin of the Agava Strophia.

The Fort Charlotte Strophia may be known by the peculiar oval form, less wide aperture, and reddish color. This species resembles S. glans more than it does any other shell in form, but in S. glans the shell is white, and the aperture rather higher than wide and the margin thicker.

HABITS AND DISTRIBUTION.

Strophia carlotta occurs in the immediate vicinity of Fort Charlotte, New Providence. The type locality is at the foot of the hill, on which the fort stands, on the north side. Here they were found on low bushes and herbage. Further up the hill toward the fort, almost under the shadow of the walls of the small old Spanish fort, which stands a little to the eastward of the large structure, occurred the small form No. 1.

To the westward of the type locality, nearer the bushes and among them, we collected the larger from No. 2.

I think the origin of the dwarf form can be traced directly to the dryness of the soil on the hill top. At the time of my visit in March, 1893, the foliage of the shrubbery was so parched with heat and lack of moisture that it crumbled in the hand. We have seen another instance where a dwarf form has been produced by a dry environment in Strophia nana, on Little Cayman, but the extreme pigmy size of this species was also probably due, partly, to feeding upon a peculiar plant. See Vol. I of these contributions, page 27.

45 STROPHIA GLANS Kuester.

Acorn Strophia.

Fig. 50, A, front view, B, side view, of type form.

Pupa glans Kuester in Chemn. ed. II, Pupa, page 74, plate II, figs. 1 and 2.

DESCRIPTION.

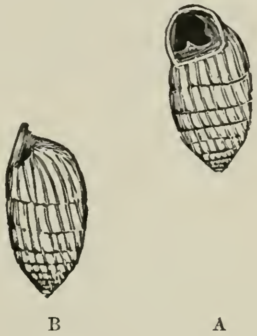
Sp. Ch. Size, rather below medium. Shell, not heavy. Striations, present. Whirls, ten, Examined 1,000 specimens.

Form of shell, a pointed oval, with the first and second whirls the largest, then the shell slopes to a rather acute point, forming an angle of sixty-five degrees. The striations are rather numerous, twenty-one to the first whirl, are not prominent, but are regular, narrow, about as wide as the interspaces and a little flattened, but smoothly rounded and polished. They are slightly inclined from right to left, but are not arranged in lines.

Aperture, small, arched, about as wide as high, open, and not contracted at the entrance. Lower tooth, rather prominent, .05 high, about as wide as high, and about twice as long as high. It is placed quite near the frontal bar, not quite once its length, is not elevated, and is about central in position. The upper tooth is but slightly developed, being a mere tubercle.

Margin, not produced forward as far as the diameter of the shell, and placed rather to the right of the center, and is not inclined to the right. It is thin, a little thicker than the shell behind it, and although it is produced into a blunt edge, this is not rolled backward. The frontal bar is not well developed, being thinner than margin, and it completely interrupts the striations.

FIG. 50.



Strophia glans Kuster. A, front, B, side view.

Color of shell, externally, dull white, shiny on the striations; within, dull brown, rather dark, fading into white on the margin, but reaching the frontal bar but the central tooth is white, in striking contrast with its dark surroundings.

DIMENSIONS.

Typical size, .92, by .45. Largest specimen, 1.00 by .50; smallest, .80 by .37. Greatest diameter, 1.00. Longest specimen, 1.15; shortest, .80.

OBSERVATIONS.

Individual variation is considerable, and is in the direction of producing a form with a thickened margin, which is sometimes rounded, sometimes beveled without being grooved, and sometimes beveled with a groove. There is also a tendency to produce a flecked form and one which is grayish in color which is inclined to be larger, with a thickened margin, and through this into the typical sub-species, S. glans grisea, next described. With all this individual variation, which are not pronounced enough to describe as distinct forms, we have three distinct forms, that are inclined to appear in locations of their own.

No. 1 is decidedly more cylindrical, the first, second and third whirls being about equal in diameter, the striations are more numerous, twenty-five to the first whirl, and they are even less prominent than in the type. While the color externally is slightly inclined to be grayish, externally; internally, it is paler, with the space in front of the tooth, and around it, white. There are about two per cent. of this form.

No. 2. Form and color that of the type, excepting that the whirls are nine, with the size small, .80 by .37. There are about four per cent. of this form.

No. 3, a large, heavy shell with, a thickened margin (about .10), that is beveled and decidedly grooved. The form is a pointed cylinder. The striations are narrower and are inclined to be angular.

As far as I can judge from an account, which, like most of the older descriptions of shells of this genus, is much too brief to clearly define any species, and from a good figure, the shell that I have described above is most undoubtedly the species which Kuster had in hand when he described his Pupa glans. Thus we can with considerable certainty establish the status of another of the old species of Strophia.

The locality from which Kuster's type came is unknown, and the following is his original description in Latin, with a translation:

"Testa rimata, ovata acutiuscula, roseo-alba, fortiter costata, costis confertis oblis; anfractibus, 10, convexusculi, angustis, ultimos fusco-subfusciatus; apertuta semiovata, intus nitida, palada flava, peristomata recurvo, incrassato, parie aperturali umplicatus."

Shell fissured (umbilicated), rather acutely oval, rosy-white, striations prominent, striations close together and oblique; whirls, ten; somewhat rounded, narrow, the last partly fusciated with fuscous. Aperture, semi-oval, polished within, and pale yellow. Peristome (margin) recurved, not thickened. Teeth of aperture, one.

The size is given as about twenty-three millimeters by ten wide and the habitat of the shell described was unknown to Kuster. Pfeiffer, however, in Monographia Heliceorum, Vol. VI, page 291, gives the locality as "New Providence, insularum Bahamensium." In Vol. I of the same work, Page 216, he substantially gives a copy of Kuster's description, but in Vol. VI, says nothing further about the shell than to give the habitat. Now from these facts we may reasonably conclude that Pfeiffer never saw Kuster's types, but fitted some shell to his description. This shell was possibly my S carlotta, but this has nine whirls, not ten, and can scarcely be called "rosy-white," nor does it resemble Kuster's figures as cited at the beginning of this article.

Now, while in some particulars, the shell, which I have decided to identify as the S. glans of Kuster, does not coincide with either his figure or description it is quite like both, so near in fact that I do not believe we shall ever find any species of the genus that will answer better, hence it seems to me best to fix upon this form and so definitely establish the status of Strophia glans.

HABITS AND DISTRIBUTION.

I found the type form of Strophia glans in some fields which lie directly south of the little settlement of Fresh Creek, but on the opposite side of the creek, in December, 1888, and again in 1893. On both occasions I found all of the forms described, but on my first visit I did not find the intergrades between this species and its sub-specific form given below.

Form No. 1 occurs in the southernmost fields about a mile from the creek, while on the borders of the creek in some rocky fields is form No. 2, while No. 3 is found among the bushes which border the fields. The Acorn Strophia lives on small shrubbery and on herbage, in the fields and about them, and is rather scattering, nowhere appearing in great numbers.

46 STROPHIA GLANS GRISEA Novo.

Gray Acorn Strophia.

Fig. 51, A, front view of type, B, margin of same.

DESCRIPTION.

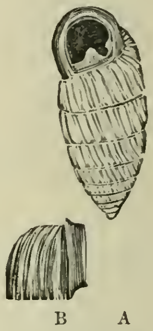
Sp. Ch. Size, medium. Shell, heavy. Striations present. Whirls, ten. Examined 200 specimens.

Form of shell, cylindrical oval, the first and second whirls being the largest and about equal in diameter, then the shell slopes to a rather acute point, forming an angle of sixty-five degrees. The striations are rather numerous, twenty-five to the first whirl. They are not prominent, narrow, not wider than the interspaces between them, are regular, inclined to be arranged in lines and rounded, but not polished.

Aperture, small, about as wide as high, rather contracted at the entrance. Lower tooth, prominent, oval, about .05 high, as wide as high and not quite as long as high, it is not placed far back, not once its length, and is not elevated. The upper tooth is a mere tubercle and is placed low, not higher than the top of the lower tooth.

Margin, produced about as far forward as the diameter of the shell, is placed a little to the right of the center of the shell and is inclined slightly to the right. It is thick (.12), beveled, and grooved. The frontal bar is not very well developed, is thin, not over .02 thick, but completely interrupts the striations.

FIG. 51.



Strophia glans grisea. A, front view of type. B, margin of same.

Color of shell, externally, grayish ash, striations and all; ashy brown, within, which color extends over the teeth, where it is paler, however, and quite to the edge of the margin.

DIMENSIONS.

Size of type, 1.10 by .45. Largest specimen, 1.15 by .47; smallest, .95 by .40. Greatest diameter, .47; smallest, .40. Longest specimen, 1.15; shortest, .95.

OBSERVATIONS

As far as the specimens which came from the type locality are concerned, this is a very uniform form of shell, there being only a slight individual variation in form and a little in color internally, but the peculiar gray tint of the external surface is very constant and characteristic. Had I never seen shells from any other locality than from the fields north of Fresh Creek, I should have unhesitatingly said that this was as strongly marked a species as I had ever seen, with strongly marked species, but it occurs in the fields on the south side of the Creek where it completely intergrades, through a small percentage of specimens with typical S. glans; hence I have been forced to consider it a sub-species.

The Gray Acorn Strophia may be known at once by the thick, grooved margin, and peculiar uniform gray color which I have not seen in any other form of Strophia.

HABITS AND DISTRIBUTION.

The first specimen of the Gray Acorn Strophia that I ever saw were brought to me by some Creole boys, but I soon discovered the typical locality, which were some fields north of the creek, about a mile from the settlement, and by the side of the road which leads northward to Calabash Bay. Here they were not common and were clinging to the bushes along the margin of the cultivated fields. South of the creek the few that I found were also clinging to bushes either in the fields or along the borders, but here they were even more rare than in the type locality. These specimens on the south side were undoubtedly transplanted from the north side through the agency of the inhabitants, who pass from one set of fields to the other, carrying with them the plants of the casava on which the Strophias frequently occur.

47 STROPHIA REGULA Novo.

Regular Strophia.

FIG. 52, A, side, B, front view of type.

DESCRIPTION.

SP. CH. Size, large. Shell, not very thick. Striations present. Whirls, twelve. Examined fifty specimens.

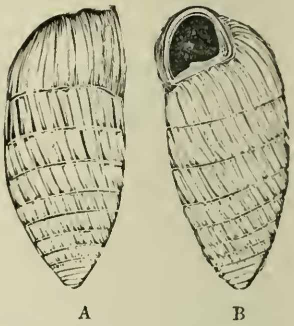
Form of shell a pointed cylinder, with the first, second and third whirls about equal in diameter, the fourth is but a little smaller, then the shell slopes to an acute point, forming an angle of sixty-two degrees. The first whirl is comparatively short, being only as long (measured in front) as the next four whirls below it, all together. The second whirl is shorter than the third and fourth, together, then each successive whirl is shorter than the next two below it. The striations are numerous, twenty-nine to the first whirl, they are narrow, about as wide as the interspaces between them, are rather angular, but are slightly flattened on top, not furrowed, but smooth, are very regular, and of about the same width for their length on each successive whirl, and are arranged in lines with scarcely an interruption on each line, from the first whirl to the apex.

Aperture, rather small, arched and about as high as wide, and is slightly contracted at the entrance.

Margin, produced forward about as far as the diameter of the shell, is slightly inclined to the right, a little beyond the diameter of the shell, is thin, about as thick as the shell behind it, with the edge smoothly rounded. Behind it, the shell is much roughened with lines of growth, which, on the sides project, showing an inclination to form a double margin. The frontal bar is well developed, protruding considerably beyond the striations, and is about as thick as the margin.

Color of shell, dull white throughout, pale brown within, becoming paler on the margin.

Fig. 52.



Regular Strophia. A, side, B, front view of type.

DIMENSIONS.

Size of type, 1.50 by .60. Largest specimen, 1.50 by .63; smallest, 1.15 by .50. Longest specimen, 1.50; shortest, 1.15. Greatest diameter, .62; smallest, .50.

OBSERVATIONS.

As all the specimens of this fine shell that I ever saw were occupied by a species of hermit crab, which always smooth away any inequality in the shells of which they take possession, the teeth were always worn nearly or quite away. Judging from the remains of the lower in the type, I should say that it had been large and prominent.

Individual variation is toward a smaller form, 1.15 by .50, with eleven whirls, and also toward a form with more widely-apart and less regular striations, but all preserve the short upper whirl which is so characteristic of this species. In S. glans, S. bimarginator, and other species found on Andros, as far as I have seen them, excepting one to be described later, the upper whirl is about as long as all the other whirls together. Aside from this peculiarity, S. regula may be at once distinguished by the large size, narrow, equally wide striations, arranged in lines across the rather narrow whirls, which have shallow sutures, that are not notched, thus the whole combination makes up one of the most beautifully regular species of Strophia that I have ever seen, being excelled in this respect only by S. dallii, from Inagua, but, of course, S. dallii belongs to an entirely different sub-genus ; see page 130 of Vol. I of these Contributions.

Since a large portion of the present instalment of my monograph has been put into type, I have received Dr. Dall's paper on the shells collected during the " Cruise of the Steam-yacht ' Wild Duck ' in the Bahamas, January to April, 1893, in charge of Alexander Agassiz," which paper occupies No. 9, of Vol. XXV, Bulletin of the Museum of Comparative Zoology. On pages 121 to 123 of this paper Dr. Dall has named the groups which I suggested were clearly separable, considering them, as being at least sub-generic.

Dr. Dall's names for the sub-generic groups suggested by me are as follows, the characters, however, are from the earlier pages of my Monograph :

1. DIACERION.

LOWER TOOTH GREATLY ELONGATED, CHANNELED; POSITION CENTRAL. S. dalli Mayn. is Dall's type.

2. STROPHIOPS.

LOWER TOOTH ELONGATED, SIMPLE; POSITION CENTRAL. Type given by Dall, Pupa ducamana Fer.

3. MAYNARDIA.

LOWER TOOTH, SHORT, SIMPLE; POSITION CENTRAL. Dall's type is S. neglecta Mayn.

4. CERION.

LOWER TOOTH, SHORT, SIMPLE, POSITION NOT CENTRAL. Dall's type is Turbo uva Linn.

5. EOSTROPHIA.

LOWER AND UPPER TEETH ABSENT. Type, E. anodonta Dall. This last group was defined by Dall in Cf. Trans. Wagner Inst., Vol. III, No. 12, August, 1890.

As an additional sub-generic character for Maynardia I will add that the young of all the Bahama Strophias, with one exception (see S. bimarginata), which I have examined belonging to this sub-genus have a single tooth, there never being even an indication of any other (see fig. 33, page 108, of this volume of Contributions and compare with figs. 1, D, and 5, C, plate II, vol. I.

[Note. In the paper cited above, Dr. Dall shows that the name Strophia Albers, 1850, must be abandoned for this genus, as it has not only been superceded by Cerion Bolton, 1799, but has also been preoccupied in Entomology (Mergen, Syst. Beschr. III, 147, 1832). To avoid confusion, however, I shall continue the name of Strophia until the close of this Monograph.]

HABITS AND DISTRIBUTION.

The only specimens that I ever saw of this beautiful Regular Strophia, were, as remarked, occupied by the young of a species of Hermit crab, Diobeta diogines, and appeared to be quite a favorite shell with them. The crabs with their adopted shells were found on both sides of Fresh Creek near the settlement. Some of the shells appeared to be quite old and much stained, but some were comparatively fresh ; for example, the type, which I have figured, aside from the wearing away of the teeth and a small hole broken near the margin on the left side, is perfect, and the color of the internal parts is well preserved. But we could not discover any living specimens anywhere, although we searched with great care. It is probable. therefore, that Strophia regula is also an extinct species ; but still it is possible, that the shell is to be found at some distance up the creek, the specimens found having been brought down by the out-going tide. and stranded on the shore where they could be found by the crabs. But I made a careful search of both banks of the creek for at least two miles from the settlement, and found no trace of a Strophia, of any kind, after leaving the immediate vicinity of the settlement. Then again, I do not think it probable that a species of Strophia would occur far from the coast, for I have never found one far from the sea.

48 STROPHIA BIMARGINATA Novo.

Double-Margined Strophia.

Fig. 53, A, front view, B, side view, of type ; C, young (enlarged), D, double margin of another specimen.

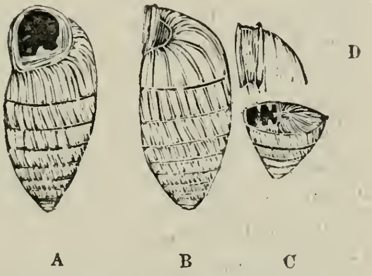
DESCRIPTION.

Sp. Ch. Size, medium. Shell, of medium thickness. Striations, present. Whirls, ten. Examined 2,000 specimens.

Form of shell, a pointed cylinder, the first, second and third whirls being about equal in diameter, then the shell slopes gradually to a rather blunt point, forming an angle of seventy degrees. The striations are not very numerous, twenty-three to the first whirl; they are rather regular, narrow, not quite as wide as the interspaces, are inclined to be triangular, but are slightly rounded, smooth, but somewhat furrowed, are only partly arranged in lines and a little inclined from right to left.

Aperture, quite small, inclined to be rounded, open at the entrance, but contracted within. Lower tooth, prominent, double, with the second smaller and placed on the left of the larger; the larger tooth is about .05 high, about as wide as high and not twice as long as high, the smaller one beside it is about half as large and is closely connected with the larger; both are somewhat elevated, are about central in position, and are placed back a little less than once the length of the larger from the central bar. The upper tooth is a mere tubercle, is elevated a little above the top of the lower tooth and the space between the two is inclined to be filled up.

Fig. 53.



Strophia bimarginata. A, front view; B, side view of type. C, young, enlarged, D, margin of another adult specimen.

Margin produced forward about as far as the diameter of the shell, it is thin, about as thick as the shell behind it, and is smoothly rounded, without being produced into any edge. Immediately behind this first margin is a second margin with the edge roughened and between this double margin the shell shows lines of growth, having, in fact, formed the inner margin first, then, after adding more to the shell, formed a new margin. The frontal bar is well developed and completely interrupts the striations.

Color of shell, externally, pure white, rather lustrous, internally, pale brown, a little darker in shade well within the shell, and becoming white on the margin.

DIMENSIONS.

Size of type, 1.07, by .45. Largest specimen, 1.20 by .55; smallest, .80 by .35. Greatest diameter, .55; smallest, .35. Longest specimen, 1.35; shortest, .80.

OBSERVATIONS.

Individual variation is considerable and extends in several directions. The form is sometimes shorter and wider proportionally, much as in S. glans, and the margin is thinner and less inclined to be double, but is never beveled as it is, and differs from S. glans, in maintaining the small rounded aperture. Some specimens are also more cylindrical and smaller in diameter. The double tooth occurs only in perfectly adult specimens and is not always present then. This would also appear to be a character which seems strongest in individuals which are placed in exposed situations, and thus now is rather of a secondary specific character, but as the species becomes more fixed, the double tooth will become more constant; it is present, however, is about seventy-five per cent. of the specimens obtained on Green Key, the locality of the type, and in about 50 per cent., or a little less, of the specimens from Little Galden Key.

The double margin of this species is a singular character, and one which I have not seen in any other species of Strophia. It is present in a more or less marked degree, in nearly all adult shells, but sometimes the doubling is represented by lines of growth on a simple grooved and beveled edge; possibly, even in these cases, there will be another margin formed. In the example given in Fig. 52, D, there has been two distinct margins formed, both beveled, grooved, and marked with lines of growth, a significant fact and one to which I will refer again.

In this connection it is worthy of remark that I have a single specimen of S. glans in which two distinct margins have been formed, a considerable distance apart, but I shall figure this specimen and refer to it later.

The doubling of the margin and of the teeth in this species appears to have sometimes caused reversion to some long past ancestral type, which was the common ancestor of all the sub-genera of the genus, for in this species we find that several teeth appear in young shells, at least I have one specimen, a very young shell, with five whirls only, in which five teeth appear, almost exactly as seen in the young specimen of S. pannosa and of S. festiva figured on Plate II, Vol. 1 of these Contributions. Compare these figures with Fig. 52, D, of the present volume, where I give a figure, twice enlarged, of a young S. bimarginata, taken on Green Key, in April, 1893. I have also another specimen, from the same place, that is older, which has, besides the tooth in the usual place on the column, another on the upper portion of the walls of the aperture and two indications on the larva. Other older specimens have simply the one tooth as seen in all other members of the sub-genus Maynardia, but I should not be at all surprised to find this character appearing, at least occasionally, in very young specimens of other members of this sub-genus. As also showing a tendency to revert to ancestral types, I have two adult shells in which there is no indication of any teeth whatever. (See remarks regarding the form of sub-genus Eostrophia on page 163.)

I have remarked that the type form of this species came from Green Key, off Andros, but this species also occurs on Little Galden Key, Middle Bight, Andros. But the shells from this latter-named place here have caused me no little perplexity. They appear different from those on Green Key, as they lie in mass in the boxes, side by side, and I considered them different when I collected them, but when I try to get at some exact character which will separate the shells from the two islands I utterly fail to find any which will answer even to represent a form. All I can say, is, that, on the average, or taken in mass, the shells from Little Galden Key are larger, coarser and darker in color, internally, and with an inclination to a creamy tint, externally.

There are, however, two forms, one of which is also found on Little Galden Key, and a well-marked sub-species, developed on Green Key.

No. 1 is a large, coarse form, with an inclination to assume a bevelled margin and single tooth, with a darker interior. This form also appears on Little Galden Key, but here is even larger with a decidedly creamy color externally. On both keys the shell is found in the thicket away from the beach.

No. 2 is a small form, the smallest dimensions given, with a thin margin, and with a tendency toward a single tooth, although this is sometimes doubled. The color is dicidedly bluish, and I have two or three specimens which are considerably flecked. This form occurs among the low grass of the rocks of Green Key.

HABITS AND DISTRIBUTION.

All along the eastern coast of Andros stretches a barren reef which varies in distance from the island from one to five miles. This reef is continuous excepting where it is broken at the entrance of the bights or creeks that make into the land. Here and there, along this reef which divides the lagoon between it and the land from the deep water of the Tongue of Ocean rose little islets varying in size from the merest points of rocks, just awash by the waves at high water, to keys ten acres in extent which rose sometimes thirty or forty feet above high water. One of those large islands is called Green Key. [Of keys of this name I know three: one near New Providence, one here on the coast of Andros and one (a large key) about thirty-five or forty miles south of it, but on the opposite or eastern side of the Tongue of Ocean.]

This key contains about five acres of land. It is rather low, backed on the eastern or seaward side, by rough jagged rocks which are somewhat elevated, and, on the western side, along the lagoon, by lower, smoother rocks. Directly on the water the rocks are exposed, but back of them the key is covered with a dense growth of bushes. It was along the lagoon border that we found Strophia bimarginata.

They were clinging in clusters of from five to twenty-five or thirty individuals to the grass and herbage along the margin of the bushes, but were seldom found on the bushes themselves, but deeper in among the bushes we found the larger form No. 1. while form No. 2 was found on the lower herbage nearer the water.

On Little Galden Key, Middle Bight, which I have described on page 29 of these Contributions, we found the shells in a similar situation, but never on either key on the eastern or seaward side. I also found a form, corresponding to No. 1, in the woods at Little Galden Key.

49 STROPHIA BIMARGINATA CERA. Novo.

Waxy Strophia.

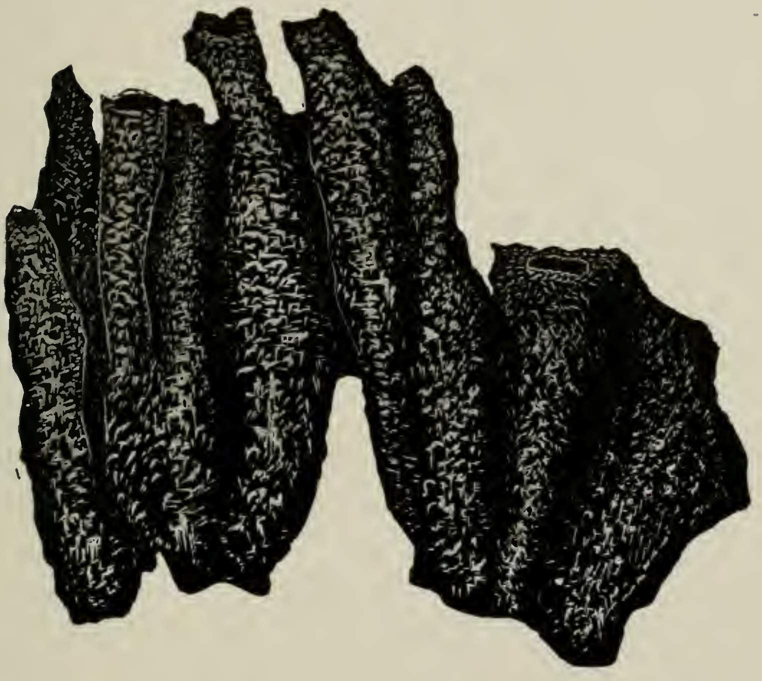
Fig. 54. A, front view, B, margin, of type.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, thin and light. Striations, present. Whirls, ten. Examined nine specimens.

Form of shell, a pointed cylinder, with the first three whirls

PLATE X



VERONGIA INSULARIS.
Life size. Type from edge of bleached specimen.
Nassau Harbor. April, 1893.

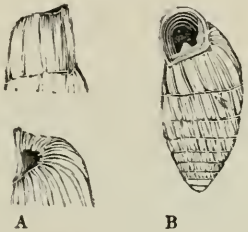
equal in diameter, then the shell slopes to a moderately acute point, forming an angle of sixty-two degrees. The striations are not numerous, twenty to the first whirl, they are narrower than the interspaces between them, regular, and somewhat broken, but smoothed on top, not arranged in lines, and are slightly inclined from right to left. The spaces between them are narrow, with one or two distinct lines or ridges of growth.

Aperture, rather small, arched, but open, and inclined to be rounded. Lower tooth, prominent, inclined to be double, about .03 high, wider than high, and about twice as long as wide, is slightly elevated, and placed in a central position and back not quite once its length from the frontal bar. The upper tooth is represented by a mere tubercle.

Margin, not produced forward quite as far as the diameter of the shell, is about twice as thick as the shell behind it and is smoothly rounded, with the sides slightly furrowed with lines of growth. The frontal bar is quite well developed and protrudes a little beyond the striations.

Color of shell, externally and internally, is a beautiful waxy white, without tinting or marking of any kind.

FIG. 54.



Strophia bimarginata cera. A, front, B margin, of type.

DIMENSIONS.

Size of type, 1.00 by .40. Largest specimen, 1.07 by .47 smallest, .97 by .45. Greatest diameter, .47 ; smallest, .40. Longest specimen, 1.07 ; shortest, .97.

OBSERVATIONS.

Individual variation, on one hand, is toward the parent stock, S. marginata, the margin being wide, but never double, and the interior slightly tinted with very pale brown, and on the other hand, toward specimens with a thinner margin, showing no lines of growth and a single small tooth as beautifully white in color as in the type.

There is a singular resemblance between this sub-species and

Strophia curtissii nivia in color and somewhat in form, but S. b. cera is larger, with a smaller aperture, more widely apart striations, with lines of growth between. From all other Strophias this sub-species may be distinguished by the peculiar waxy color and thin shell, which is nearly as translucent as white wax, insomuch so that the animal may be seen through it.

HABITS AND DISTRIBUTION.

The few specimens of this fine Strophia which I obtained were taken from trees or bushes on Green Key.

50 STROPHIA PILSBRYI Novo.

Pilsbry's Strophia.

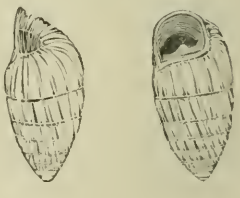
Fig. 55. A, front, B, side view of type.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, rather thin and light. Striations present. Whirls, ten. Examined 125.

Form of shell, an elongated pointed oval, the first whirl being the largest, the second, third and fourth being successively a little smaller, then the shell slopes a little more rapidly to an acute point, forming an angle of sixty-three degrees, The first whirl is short, equalling in width the next four. The striations are not numerous, twenty-two to the first whirl, are a little narrower than the interspaces between them, inclined to be angular, slightly ridged, with ridges of growth between them are not very regular, not at all arranged in lines and not in the least inclined, being straight from the upper whirl to the apex.

Fig. 55.



Strophia pilsbryi. A, front, B, side view, of type.

Aperture, quite small, open, not at all inclined to the right. Lower tooth, not prominent, triangular, being as wide as high, and a little longer than wide. It is very slightly elevated, and set back from the frontal bar not quite its length.

Margin, single, not produced forward quite as far as the diameter of the shell, it is thin. a little thicker than the shell behind it, is smoothly rounded, and produced backward into a blunt edge, While the frontal bar is quite well developed, it does not project much beyond the striations.

Color of shell, externally, pale ashy blue, becoming horn color on the apex, and waxy white on the margin, which extends backward past the teeth when the shell becomes quite abruptly brown, with almost a sharp line of demarkation.

DIMENSIONS.

Size of type, 1.07 by .45. Largest specimen, 1.09 by .45; smallest, .87 by .37. Longest specimen, 1.09; shortest, .87. Greatest diameter, .45; smallest, .37.

OBSERVATIONS.

Individual variation is not great. As might be expected, there is some marks of reversion toward the type form, which, as I shall clearly show, must have been S. bimarginata, and this reversion takes the form which we should most expect, that of the double tooth, but this is never as marked as in typical S. bimarginata, and out of the one hundred and twenty-five examined I have found twenty only, and in more than one half of these the central tooth had the slightest indication only of the doubling.

This double tooth is never accompanied by the double margin, and the only indication of the feature so prominent in S. bimarginata is a slight furrowing of a thickened and beveled margin in some specimens.

There is a decided inclination to produce a form with fewer striations, some, in fact, being nearly smooth on the upper whirl.

There is one decided form, and that is one in which although the form has not changed, the color has become reddish ash throughout, striations and all. This color appears in intermediate specimens on the apex, thence gradually spreads, through other specimens, over the entire shell. Some adults are slightly flecked. This is the form through which the sub-species next described, S, p. evolva, was derived.

I have named this interesting species of Strophia for Mr. A. H. Pilsbry, the accomplished curator of conchology at the Academy of Natural Sciences, Philadelphia.

HABITS AND DISTRIBUTION.

I have said that Little Galden Key lies at the entrance of Middle Bight, and about a half mile directly west of it is a long, narrow islet, called Goat Key, thus it is situated well within the Bight; but owing to the trend of the southern shore of the Bight it is quite near this portion of the main island. The key is only about one eighth of a mile long, and nowhere over fifty yards wide. This little spot of land. however, is of great interest from a conchological point of view, for it not only contains two distinct species of Strophia and one sub-species, but these forms are in themselves remarkably interesting, as will be seen.

So important is this Key, and the Strophias which live upon it, that I have given a little chart of it (See Fig. 56) which, although accurate enough, perhaps, for the purpose for which it is intended. must be regarded simply as a diagram.

Fig. 56.

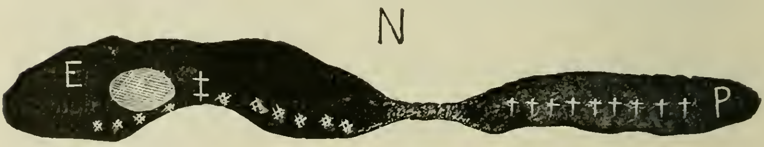


Diagram of Goat Key, Middle Bight, Andros. P, eastern portion of Key, E, western; †, sections inhabited by Strophia pilsbryi. ⚬, section inhabited by S. p. evolva. ‡, spot inhabited by S. restricta.

As will be seen by consulting the figure, also, the key is nearly divided into two parts, these two parts being connected, in fact, by a narrow sand bar over which the water flows during very high tides. The easternmost portion is surrounded by a sand beach, but the central portion is higher and is covered by a spare growth of bushes. This portion of the key is the home of Pilsbry's Strophia, but it was not common there at the time of our visit in April, 1893. The form No. 1, which I have indicated, occurred toward the western end of this portion. I have noted the range of the Strophias by a number of †s.

51 STROPHIA PILSBRYI EVOLVA Novo.

Pilsbry's Mottied Strophia.

FIG. 57, A, front view, B, margin, of type.

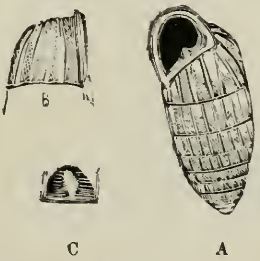
DESCRIPTION.

SP. CH. Size, rather small. Shell, rather heavy. Striations present. Whirls, ten. Examined seventy specimens.

Form of shell, a pointed cylinder, with the first and second whirls equal in diameter, the third is but little smaller, then the shell slopes to a point, forming an angle of sixty two degrees. First whirl, short, equal to the next four smaller. The striations are not numerous, twenty-two to the first whirl, are rather regular, but somewhat broken, narrow, not as wide as the interspaces between them, smoothly rounded, polished, but some of them are slightly furrowed, and the interspaces are slightly ridged with lines of growth.

Aperture, rather small, arched, about as high as wide, and is slightly wider within than at the entrance. Lower tooth, not very prominent, .03 high, wider than high, and a little more than twice as long as high, it is not elevated, but the floor of the entrance slopes away from it, and the tooth is projected forward nearly to the frontal bar. Its position is about central. Upper tooth is a mere tubercle.

FIG. 57.



Strophia pilsbryi evolva. A, front view, B, side view of type. C, Lower tooth as seen from above.

Margin produced forward about as far as the diameter of the shell, and is considerably inclined toward the right, quite beyond the diameter of the shell, it is thick, about .07, beveled, grooved, and very faintly marked with lines of growth. The frontal bar is quite well developed, protruding slightly beyond the striations, and is very obliquely inclined to the right.

Color of shell, externally, ashy yellow, mottled and blotched with ashy brown, the mottlings assuming a transverse direction, somewhat as in Strophia mumia; internally, dark brown, which color extends quite to the margin, leaving the tooth, however, pale, and the margin nearly white.

DIMENSIONS.

Size of type, 1.12, by .43. Largest specimen, 1.17 by .43; smallest, .90 by .40. Greatest diameter, .43; smallest, .40. Longest specimen, 1.17; shortest, .85.

OBSERVATIONS.

Individual variation is great, and the most noticeable is toward producing a white form, which is clearly a reversion toward typical S. pilsbryi, in fact, this form grades directly into the parent stock.

Another variation, which may be considered as progressive, is toward producing a shorter, thicker form, with nine whirls and with numerous striations, thirty to the first whirl, they are regular, and not wider than the interspaces, and the first whirl is as long as the first five, while the aperture is inclined to be rounded, and more in the centre of the shell than in the type. The color is also dark, nearly uniform ashy brown, but with central tooth as in the type. I notice this form particularly as I believe that it will be found somewhere, at some time, as an established species.

Directly opposite this is a larger form, more cylindrical, with the first three whirls equal in diameter, and with the transverse mottlings more pronounced. This form seems to mark the direction in which the sub-species is trending to establish a full-ranked species. Occasionally a specimen will show a double margin.

As will be seen, the characters which mark this fine sub-species are, first, and most important, the elongated central tooth projected well forward, toward the frontal bar, a remarkable character and one which I have never seen so prominent in any other species of this genus; second, the form of the margin, with its oblique bar; thirdly, the peculiar mottlings, recalling those of S. mumia. Besides, we have the usual characters which almost always accompany the evolution of a dark, mottled form of shell from a white form, namely, the thickening of the shell and contraction of the margin. All of these characters in combination, together with the fact that this form has a location of its own, go to make up good and sufficient specific characters and I would so consider them, but there is yet too great a number of specimens which must be considered as intermediate.

HABITS AND DISTRIBUTION.

This strongly marked sub-species occurs on the bushes of the western and larger portion of the Goat Key, (E, in the chart, fig. 55,) but along its southern border; I have marked its range with a series of ◌s. The form is not abundant in numbers and rather scattering.

52 STROPHIA RESTRICTA Novo.

Restricted Strophia.

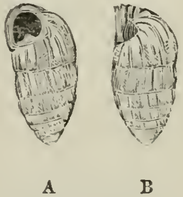
Fig. 58. A, front view, B. side view, of type.

DESCRIPTION.

Sp. Ch. Size, very small. Shell, rather heavy and thick. Striations, present. Whirls, nine. Examined seventy-five specimens.

Form of shell, an elongated oval, the first and second whirls being about equal in diameter, the third is a little smaller, then the shell slopes to a rather acute point, forming an angle of fifty-eight degrees. The striations are quite numerous, nineteen to the first whirl, are about as wide as the interspaces between them, are beautifully rounded and polished, very regular and arranged in lines.

Fig. 58,



Strophia restricta. A, front, B, side view.

Aperture, very small, not quite as wide as one half of the shell, arched, and about as high as wide. Lower tooth, not prominent, about .03 high, as wide as high, and about twice as long as high. It is not elevated, and is set back nearly once its length from the frontal bar. Upper tooth, absent.

Margin produced forward about as far as the diameter of the shell, it is nearly straight and not inclined to the right. It is about as thick as the shell behind it, beveled below on either side, marked with fine lines of growth, but doubled above with lines of growth between the two divisions. The frontal bar is well developed, and protrudes beyond the striations, and is but little inclined.

Color of shell, externally, ashy white, mottled, but not transversely, with reddish brown. Internally, brown, rather dark in shade, extending quite to the margin, but this and the tooth are paler.

DIMENSIONS.

Size of type, .75 by .32. Largest specimen, .92 by .37: smallest, .62. by .32. Greatest diameter, .37; smallest, .32. Longest specimen, .92; shortest, .62.

OBSERVATIONS.

Variation is toward a slightly larger form, but with about the same proportion, but with a beveled margin with lines of growth only, also toward a more pointed form with the first whirl the largest. There is also the following distinct form :

No. 1. White in color, and with a tendency to assume a less number of striations. The margin is beveled and grooved, but in some individuals is doubled.

This singular little Strophia may be distinguished from S. thorndikei, which it resembles somewhat, by the heavier shell, thicker margin, smaller aperture and different color. I know of no other Strophia which it resembles.

HABITS AND DISTRIBUTION.

About midway on the southern side of the western portion of Goat Key is a little bay, and on the western border of it is a small mangrove swamp. A sand beach entirely surrounds this portion of the key, but along the little bay, especially to the eastward of the mangrove swamp, the land being low (for the mangrove swamp evidently represents an old lagoon) the sand has encroached upon the land considerably. This sandy tract, however, in the immediate neighborhood, is covered with bushes, or small trees. It was on one of these little trees and on a few shrubs very near it that I found the colony of the singular little Strophia restricta.

On Goat Key one can learn a lesson in the evolution of species of Strophia which will prove of great value to him. Here on this little spot of land, at most not over three acres, we find three distinct forms of this genus of shells; and be it remembered that this island is distant from Little Galden Key only about a half mile, yet, as seen, it is impossible to assign even characters which will define a form to the Strophias which live on Green and Little Galden Keys, and these islands are about fifteen miles apart! Facts like these have already caused me to remark that I feel that it is far too early in my studies of this genus to even speculate on the origin of many of the species, and more especially on the origin of all the groups, and their connection with one another.

One thing is clear, however, that the Strophias inhabiting Goat Key were derived directly from the S. bimarginata of Little Galden Key. First, S. pilsbryi, through this the dark, flecked S. p. evolva, and this sub-species gave rise, most strangely, to the little dwarf, S. restricta. The most sceptical regarding the value of color as a specific character has only to visit this key and note the transition of S. pilsbryi into its sub-specific form, with its accompanying correlative characters, while the little S. restricta exhibits clearly how closely one species may live to another and yet be distinct. The sand from which grew the tree and bushes on which I found S. restricta isolated this form as completely, if not more so, than if miles of ocean rolled between them.

I have said under the Habits of Strophia nana (Vol. I Contributions, page 28) that this Strophia had the most limited distribution of any animal with which I was acquainted, but in this respect it must yield the palm to S. restricta, for this species was confined to a single tree and the bushes that came in direct contact with it, in fact, all of the specimens which I collected I gathered without moving a single step.

53 **STROPHIA EXIMEA** Novo.

Choice Strophia.

Fig. 59. A, front, B, side view of type.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, not very thick. Striations, present, but very fine. Whirls, ten. Examined 1,000.

[Note. This species and the next following belong to a peculiar group of Strophias, which may, with perfect propriety, be placed in a separate sub-genus which may be characterized as follows:

6. MULTOSTROPHIA.

Central tooth, slight, not thicker than high, striations, numerous, exceedingly fine and polished. Type, Strophia eximea Mayn. Locality, Bahamas.]

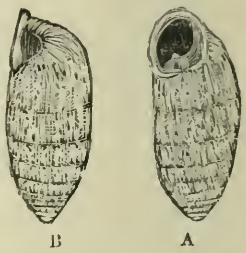
Form of shell, cylindrical, with the first three whirls equal in diameter, then the shell slopes gradually to a blunt point, forming an angle of sixty-five degrees. The striations are very numerous, fifty to the first whirl, they are rounded, regular, being half cylinders, and they are very slightly inclined from right to left.

Aperture, large and open. Lower tooth, small, .03 high, thinner than high, but about three times as long as high, is set very far back, nearly twice its length from the frontal bar. A ridge extends from tooth to the third whirl. Upper tooth absent.

Margin produced forward about as far as the diameter of the shell, is placed very nearly in the centre of the shell and is not inclined to the right, is about twice as thick as the shell behind it, is smoothly rounded on the edge and rolled over into a rather sharp edge. The frontal bar is not well-developed and does not cross the shell, being broken in the middle, hence does not completely interrupt the striations, which appear within it.

Color of shell, externally, white, beautifully marked with longitudinal and rather continuous streaks of dark reddish brown. Internally, far within the shell, pale brown becoming white on the entire margin, tooth, and space around it, with a slight creamy tinge.

FIG. 59.



Strophia eximea. A, front, B, side view of type.

DIMENSIONS.

Size of type, 1.12 by .45. Largest specimen, 1.12 by .47; smallest, .75 by .37. Greatest diameter, .47; smallest, .37. Longest specimen, 1.30; shortest, .97.

OBSERVATIONS.

There is considerable individual variation, one is toward a cylindrical form with even more numerous striations, sixty to the first whirl, with a contracted aperture, and eleven whirls. A color variation is a paler form with rather narrow markings, which are also paler. There is a tendency to produce a form with an entire frontal bar.

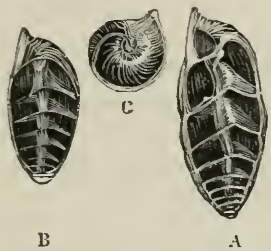
There is also the following well-defined form:

No. 1. Size, very small. Whirls, nine. Color, form and striations as in the typical form.

This is not the Pupa martensiana of Weinland for in that species the teeth are given as two and the margin as being thick. S. eximea may be distinguished from all other shells of this sub-genus by the large size, in the type form, and always by the dark, wide longitudinal markings.

There is one remarkable character in this species which is found in all the forms and one which is, as far as I have examined, peculiar to this Strophia, although I shall expect to find it occurring in others. That is a swollen ridge which, beginning back of the central tooth, winds about the column about once its width from it, thus leaving a furrow between it and the column, extends, gradually lessening in size, and it is lost in the third whirl. This ridge was once the resting place of the central tooth, and in one place, in one of the specimens examined, a tubercle still remains on at the partition in the lower portion of the second whirl. See Fig. 61, A, being a section of a specimen of S. eximea, and the tubercle may be seen in the second whirl. This elevated ridge is no thicker than the other portion of the floor of the whirls, consequently has a corresponding hollow beneath. Nothing of the kind appears in the apparently closely-allied species S. agrestina, where the floor of the whirls is perfectly simple. See Fig. 61, B, where I have given a section of S. agrestina. C, is a cross-section of the top whirl of S. eximea, showing the central tooth and beginning of the ridge.

FIG. 61.



A, section of S. eximea. C, cross section of same. B, Section of S. agrestina.

HABITS AND DISTRIBUTION.

All that I can give under this heading is the fact, that the specimens from which the above description was made were procured by Mr. Curtiss, in Nassau, from a creole who brought them from Cat Island.

The species is, however, not uncommon in collections, often labelled as Pupa or Strophia martensi or martensiana.

54 STROPHIA AGRESTINA_ Novo.

Grass Strophia.

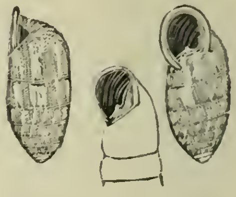
Fig. 60. A, front view, B, side view, of type. C, margin, Form No. 3.

DESCRIPTION.

SP. CH. Size, small. Shell, very thin and fragile. Striations numerous and small, but perfect. Whirls, nine. Examined 1,000 specimens.

Form of shell, quite cylindrical, but with the first whirl a little smaller than the second and third, which are equal in diameter, then the shell slopes to a blunt point, forming an angle of sixty-five degrees. Sections between the whirls very shallow. Whirls not bulging. The striations are numerous, thirty-seven to the first whirl, they are small, less than half cylinders, but rounded and perfect for their entire length, and slightly inclined from right to left, and are a little wider than the interspaces between them, while the entire shell is polished.

Fig. 60.



Strophia agristina. A, front. B, side view of type. C, margin, Form No. 3.

Aperture, very small and open, elongated and arched, but scarcely higher than wide. Lower tooth, about .02 high, about as narrow as high, and three times as long as high and is set back a little more than its length from the frontal bar. Upper tooth absent.

Margin not produced forward quite as far as the diameter of the shell, it is thin, not as thick as the shell behind it, is smoothly rounded in front, and rolled backward into a blunt, but well-developed, edge. The frontal bar is only slightly indicated, but completely interrupts the striations.

Color of shell, creamy white, externally, marked with wide, rather continuous, lines of reddish brown. Pale brown, within, fading into creamy white on the margin, leaving the tooth white, in contrast with the dark surrounding.

DIMENSIONS.

Size of type, .87 by .35. Largest specimen, 1.10 by .40; smallest, .55 by .32. Greatest diameter, .42; smallest, .32. Longest specimen, 1.10; shortest, .55.

OBSERVATIONS.

The young of this species have, as a single tooth, the upper; this is singular, as mature shells, with rare exceptions, have no trace of this tooth.

Individual variation is considerable; in one direction it is toward a form, with a larger, more rounded orifice; shells like this are inclined to have the upper whirl larger than the others, also all the whirls bulge slightly. On the other hand there is a shorter form, with straight whirls. A color variation is towards a paler form with the white predominating. As the reverse of this, I have a single specimen of a beautiful chestnut brown throughout, slightly streaked with creamy. This specimen has assumed correlative characters and is thicker with a more contracted orifice, and it is cylindrical in form, the first four whirls being equal in character. Besides these variations, which may be considered as purely individual, we find the following three well-defined forms:

No. 1. A dwarf form with eight whirls, size, .55 by .30, otherwise as in the type. This form is largely represented, at least twenty per cent. of the whole number, and I have reasons for believing that the tendency of the entire species is in this direction.

No. 2, a large form, 1.10 by .32, rather cylindrical with the first four whirls equal in diameter, with the shell thicker, and the orifice large. This form is quite largely represented, but as most of the specimens are dead shells, many of which I did not collect, I cannot give the exact percentages. The tendency is for this form to pass out of existence, or in other words, the species has passed through this form and is becoming smaller.

No. 3 is a singular form, with the first whirl decidedly smaller, and the aperture nearly central, disproportionately elongated, considerably higher than wide and with the first whirl quite small (See fig. 60, c). This form is so pronounced that it is quite likely to become specific in time.

This is not the Pupa martensiana of Wienland (See remarks on this head under Observations in S. eximea) yet it is so labelled in many collections which I have examined. This shell is very thin and fragile, so thin, in fact, that the striations can be plainly seen through it, when looking in at the aperture. I have never seen any other shell which resembles the Strophia agrestina, even belonging to this sub-genus, in this respect. The large form of S. agrestina and small specimens of S. eximea are alike in size, but differ so utterly, as described, as to be at once distinguishable, but the best character, aside from the thinness of the shell, in the Grass Strophia, is the absence of the frontal bar, this being quite well developed on either side in S. eximea.

Before closing this article I want to add a few words in regard to the shell named Pupa martensi Weinl, inasmuch as this name and that of P. martensiana are often confused, and I have even seen specimens of Strophia agrestina labelled as S. martensi.

S. martensi is a very peculiar shell, differing from most species of the striated Strophias in having a regular constriction to the striations, near the sutures, thus somewhat isolating a series of rounded knobs above each suture (there may, however, be more than one species so characterized), resembling, somewhat, a form of the little S. nana, figured on Plate II, fig. 11, B, Vol. 1, of these Contributions (See also description, page 28).

HABITS AND DISTRIBUTION.

The Grass Strophia occurs on the south side of New Providence, about opposite of the city of Nassau but distant from it some six miles. They live in pine woods, among which grow scattering palms, about a half mile from the shore, and occur under stones, fallen palm leaves, shrubs, etc., or are found clinging in clusters among the tufts of grass of which there is a scanty growth in this locality. I cannot give the exact range of this species, but I have traced it for several hundred yards along the two roads which go to the south side beach. I have found them on two occasions, one in February, 1884, and then in March, 1893. On both occasions they were quite abundant.

SUBTERRANEAN WATER WAYS IN THE BAHAMA ISLANDS.

That the Bahama Islands are of comparatively recent origin, geologically considered, will be doubted by no one who has given the matter any attention. That their existence is also due largely to the coral polyp is quite obvious, for when we come to examine the keys which make up this group of islands we find that all of them not only show marks of having once been sunken reefs of coral, but many of them are unmistakeably elevated atolls. I say elevated, for on many of the beaches, or sea borders, we find every evidence of two upheavals, possibly at not very wide intervals apart. That is, we have the present level of the higher hills and land, and on many of the keys, an old beach, or high water mark, exhibited by blocks of coral rock of varying sizes, piled in a long line, far above the present high water line, just as it was left by the waves ages ago, how long ago it is impossible to state, but since it was left on these old beaches, the coral has had time to harden somewhat, and when struck with a hammer the blocks ring like steel. It has not become silicified, however, to any great extent, as is true of the coral in similar situations on the Cayman Islands.

I have said that many of the islands are elevated atolls, and a brief examination by any one who has had any experience with coral islands, will speedily convince him of the truth of this assertion. New Providence is a series of atolls. Standing on the hill top on which Fort Charlotte is built, or, better, on the ramparts of the fort itself and looking southward and eastward one can trace a connected circular line of hills from those at his feet, through a series running southward, then gradually curving around eastward and northward to meet the same line again that extends back of the city of Nassau, on which the Government House, jail, and some other prominent buildings now stand, but considerably to the eastward of the city, in fact, in the vicinity of the little negro settlement of Fox Hill.

Enclosed in this circle of hills, which was once a great circular reef, we find a depressed, comparatively shallow basin, which was once the lagoon. The hills are not far from one hundred feet high from the sea level, but not as high above the present bed of the old lagoon, for that is elevated from five to ten feet above sea level.

I have spoken already of Highburn Key as an old elevated atoll, also of U Key and its accompanying outlying keys as another. There is an unfilled lagoon of an old elevated otall on the eastern side of Rum Key, also one at Long Key, near the northern end, while Watlings Island is an example of an existing atoll in which the reef has been but slightly elevated, the whole interior being an unfilled lagoon. Inagua is an immense atoll, some fifty miles long by thirty broad, with the interior lagoon partly filled. Around some of these keys mentioned, which I have given as prominent examples, out of many, a new circular reef is forming with a lagoon between it and the island. Such a reef is beginning at Rum Key, and at Inagua, but not to any great extent at New Providence nor at Watlings. There is a reason for the absence of the reef on these two last-named keys, which I shall give later.

Asthe Bahamas are of coral origin, there must have been a time, atno very distant geological age, when they did not exist. Looking back beyond that time, let us endeavor to find some cause for the origin of this large group of islands which now occupy a space in ocean some seven hundred miles long by one hundred and fifty wide. That is, let us endeavor to ascertain what caused the first germ of a coral polyp to establish itself on a spot where it and its successors have left such stupendous evidence of their agency, in the process of land-building, behind them.

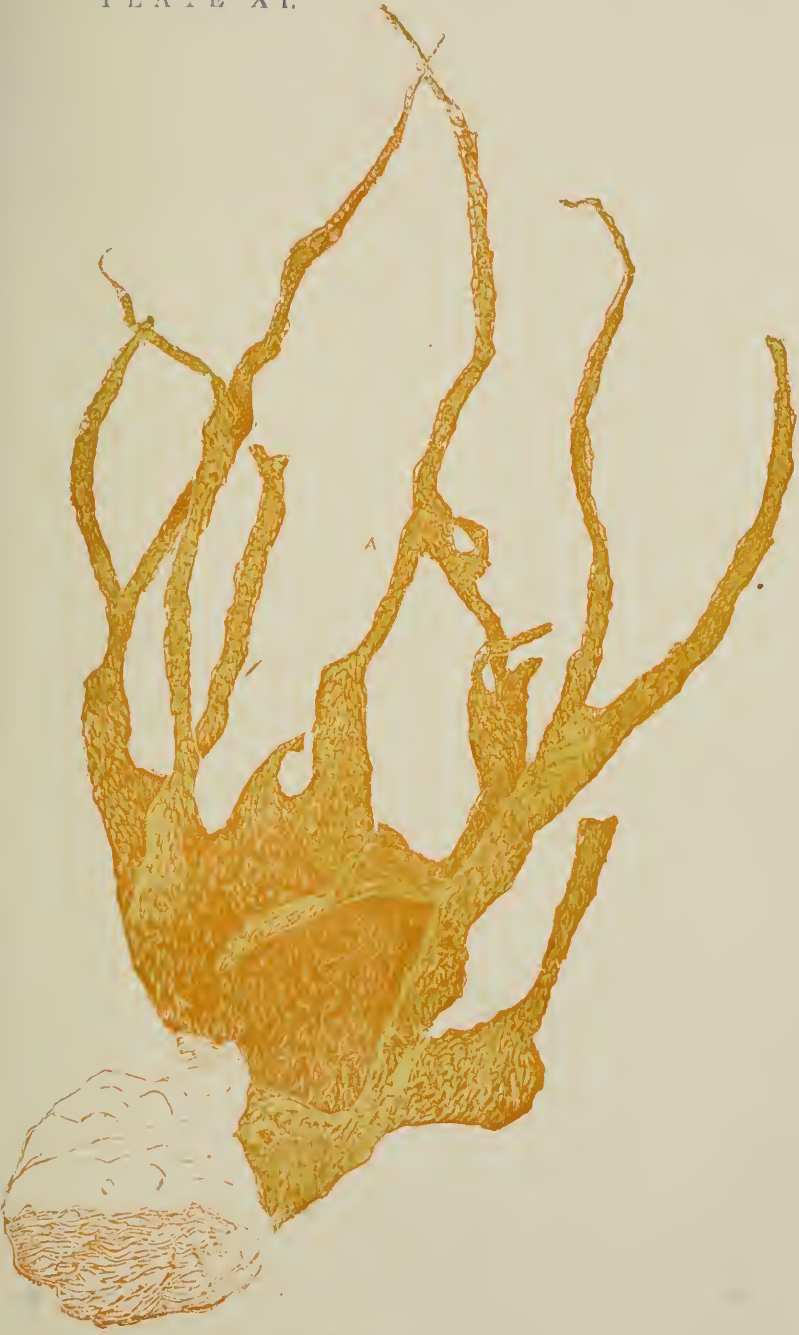
The cause of all this is most obviously that vast ocean current known as the Gulf Stream, which now flows out of the Gulf of Mexico, in an easterly direction, and, deflected by the Bahama Bank, turns quite abruptly northward, between the coast of Florida and the Bahama Banks. There must have been a time, however, before the Bahamas were in existence, when this stream was not deflected northward, but flowed unobstructed directly eastward, passing completely over what is now the Bahama Bank with its accompanying keys.

Now it is a well-known fact that reef-building corals will not grow at a greater depth than one hundred and fifty feet, and most of the West Indian species thrive best in even shallower water. Hence when the Bahama Bank had no existence, and its place was simply deep ocean, coral germs, which swim freely about for a time, could find no resting place, but the Gulf Stream, from the beginning of its flow, which was probably immediately after the elevation of the peninsula of Florida (possibly during the Miocene period), furnished material for bringing the deep ocean bed near enough to the surface for the corals to grow upon it.

Its waters were turbid with the debris brought down out of the interior of the continent by the Mississippi, Rio Grande, and other rivers which flow into the Gulf of Mexico, and possibly this debris was once even more considerable than it is now.

When the Gulf Stream was rapid the material which rendered it turbid was held in suspension, but, with the slacking of the force of the stream, which was then far out in the Atlantic, north of the island of St. Domingo, the particles gradually fell to the bottom. Thus a bank was formed which gradually extended westward and naturally, in course of time, especially after the easternmost portion became occupied by a coral reef, which formed as soon as the mud bank came near enough to the surface, also northward, thus the trend of the Bahama Bank, is as we can see by turning to any map of these islands, which is drawn upon a sufficiently large scale, in a north-westerly and south-easterly direction.

PLATE XI.



VERONGIA INSULARIS.
Life size. Filamentous form, color of living specimen
Nassau Harbor. April, 1893.

Reefs, many of them atolls, formed all over this Bank, and when the elevation came, brought about through the agency of subterranean forces, they became islands. Now a coral reef, no matter how thick it is, is not a solid wall, but is honey-combed in all directions by passages which are either left through the irregular method of the formation of coral heads, branches, etc., or from a dissolving away of the dead coral. With the elevation of the reefs, many of these passages would remain much as they were, especially in that portion of the reef which still remained below sea level, for the water would still continue to flow through them.

That such water ways do continue to remain, we have ample proof in many places in the Bahamas. On New Providence are three or four large lakes of salt water, which occur in old lagoon beds, and in which the water rises and falls with the tides of the ocean. The most distant of these bodies of water from the sea is Lake Cunningham, which lies south of Fort Charlotte and which is a little over a mile from the shore.

But among the most remarkable of the remains of the ancient passages through the reefs are what are known as ocean holes. The first instance of this that I saw was at New Providence. About a mile south of the Government House, also in the lagoon bed, in the middle of a cleared portion of land, is a depression in the rock, which is occupied by a basin of water, somewhat circular in form and about ten feet in diameter. This basin is about six feet deep, but on the north-eastern portion opens into an apparently bottomless cavity, some four or five feet in diameter, in which the water, on account of its great depth, is as blue as indigo. Through this passage this ocean hole has direct communication with the sea, and the tide ebbs and flows regularly in the basin, rising and falling between two and three feet.

There is a beautifully clear lake on the eastern side of Rum Key, the center of which is as blue as the water of the Gulf Stream, which is a huge ocean hole and which is said to be visited by turtles from the ocean.

One day while my men were pushing my boat over the shallows of the great bank which lies south of Andros, on which the water is only a few inches deep, we suddenly glided over a large ocean hole in which the water was also blue, and gazing into its limpid depths, I could perceive no bottom. The current set into this hole with the ebb, and out of it with the flood, tides.

On the south shore of Andros Island is a large ocean hole in the naked rock, about a half mile from the shore, which is some fifty yards in diameter, and which has a large spreading mangrove tree growing beside it.

Further north on Andros, about opposite Green Key, is an ocean hole remarkable for its singular form. It occurs in the naked rock as a cleft which is about a hundred yards long, but which is nowhere over twenty feet wide. To all appearances the water is of great depth in this chasm, how deep, either in this or in others of the holes mentioned, I cannot say, as I had no means of sounding them, but in this, as in others mentioned the tide rises and falls regularly with that of the neighboring ocean.

These ocean holes, are, I think, of not unusual occurrence throughout the Bahamas, and appear to connect, as seen, directly with the ocean, at perhaps no very great depth, but there is another class of subterranean water way which is even more remarkable than are the ocean holes, of which I know two only, one by actual observation and one by report. Both of these lie in Middle Bight, near the eastern opening, and from them both, as I can bear witness in one case, the water flows out constantly and with considerable force.

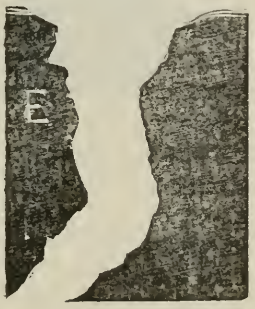
The one with which I am acquainted is situated on the side of a little islet known as Givens' Key that lies about a mile within the Bight towards the northern shore. The hole is quite near the island, about thirty yards from the beach, and being between tide-marks, the land about it is left dry by the falling water. This hole is somewhat circular in form and some ten feet in diameter, opening out of the solid rock, which it penetrates, without diminishing in diameter, for some twenty feet perpendicularly, then diminishing somewhat in size, passes obliquely under the rock to the eastward. From the mouth of this cavity the water flows with such force that it is difficult to stand upright in the stream which flows into the Bight on the north side at low tide, and it flows up to a considerable distance above the surface of the water at high tide. Just how much water is ejected by this singular orifice is difficult to calculate, but it must amount to several hundred gallons a minute.

The water is salt, and is evidently sea water, for gorgonias, especially the Briarium arbestinium, which is usually a deep water species, thrive well there, and several species of coral grow about the mouth of the cavity and in the stream that flows from it. None, however, grew far down in the cavity. I did, however, obtain the largest specimen of Briarium asbestinium that I ever saw, on the southern side of the cavity, from the top of a projecting shelf some two feet below the surface, and fine specimens of this gorgonia grew on all sides of the cavity as far as the water from the orifice flowed.

Before attempting to advance any hypothesis as to why the water constantly flows out of this singular cavity, I will explain its situation more fully by the aid of the accompanying diagram and also give a special idea of the formation of Andros Island.

In fig. 62 I have given a section of the mouth of this subterranean water way in which it will be seen just how and at what angle the passage bends to the eastward. By standing on the western shore one can see considerably further into the cavity than on the eastern side which I have marked with an E.

FIG. 62.



Section of mouth of boiling hole E, east side.

In the diagram, fig. 63, the white is water and the black land. B, is the entrance of the Bight; A, Little Galden Key; C, Goat Key; D, Givens' Key; H, the cavity, E, the south shore of the Bight, M, Mangrove Key on the north of the Bight; I, approximate position of the second boiling hole, and the dotted lines represent a shallow bank between it and the land. The scale of this diagrammatic chart is about two inches to the mile.

Andros Island, on the eastern shore of which these boiling holes are situated, is an island of somewhat peculiar formation as compared with the rest of the Bahamas. Along the eastern shore the land is quite high, often rising into cliffs. This line of cliffs is evidently an old barrier reef, similar to the barrier reef which now exists all along the eastern shore of the island, but of course the old reef has been elevated with the other of the Bahamas. West of this old line of reef, the land is low, that in the interior being rocky and covered by pine woods, but west of this it gradually merges into marl flats that by degrees, through a network of creeks and lagoons, merge into the waters to the westward.

Between this low coast and the Gulf Stream, distant about seventy miles, are comparatively shallow banks which terminate quite abruptly on the borders of the Gulf Stream, but without the intervention, as yet, of any well-defined reefs. From this gradual lowering of the land from the eastward it is easy to understand that Andros has been formed by an accumulation from the western side, and that its greatest increase has been in that direction; in fact, it is highly probable that it is only a matter of time when all the bank between

Fig. 63.

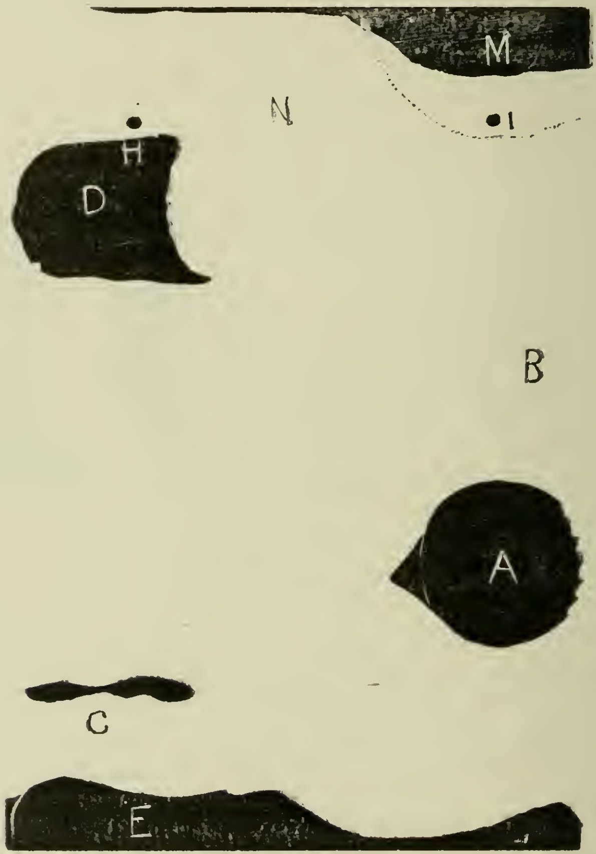


Diagram of position of keys in the entrance of Middle Bight, Andros. A, Little Galden Key, B, entrance to Bight; C, Goat Key, D, Givens' Key; E, southern shore of Bight, H, Boiling Hole, near Givens' Key; L, approximate position of second boiling hole near bank on Mangrove Key, M.

what is now the west coast of Andros and the Gulf Stream will become land. This is readily comprehended by one who has visited the southern coast of the island and seen the extremely shallow water there with little mangrove keys gradually forming and filling-in the watery area.

Now in regard to the constantly flowing water from the two boiling holes, this can be accounted for in two ways only. As shown, it is pure sea water, therefore cannot come from extreme depths, as does the sulphur water of Florida, which flows from the earth in a similar manner, as at Blue Springs, near the St. John's, and in other places. The Tongue of Ocean which lies only a little over a mile to the eastward is quite deep, and water under the pressure of considerable depths might, by being forced into a narrow passage, boil upward in that manner, but it would almost seem that the counteracting air pressure on the mouth of the passage would prevent any outward flow, and even if it came from a considerable depth would act exactly as we find it acting in the ocean holes, namely, rise and fall with the tide without any constant outward flow.

Then again, water from a great depth in the ocean would be cooler than surface water, which was not the case, or at least in any perceptible degree, and as seen it could not have been colder or corals would not have thriven in it.

After giving the matter much thought I can account for these boiling holes in one way only and that is by supposing that when the old reef was formed these passages were in it just as we find the passages of the ocean holes were, and just as we find passages through the old reef which borders the everglades of Florida on its southern side, through which subterranean streams find their way into the ocean.

The elevation of the island does not appear to have broken the connection of these ocean holes with the sea and it did not break the connection which this boiling hole had with the ocean. We have seen that in case of the ocean holes their connection was with the neighboring ocean, to the eastward of the old reef, in an extreme case, not over three miles distant, but in order to account for the boiling holes we must consider that they were connected with the waters on the westward of the reef, which was, then as now, the Gulf Stream. Before the elevation of the land this stream had practically gradually receded to what is now the western border of the island, for it is clear that the whole western portion of the key is nothing but an elevated mud bank.

In its retreat it carried the sea entrance and the passage to the boiling hole with it, until it not only reached the present western border of the island, but backward to the present border of the Stream a hundred miles from the mouth of the boiling hole.

Now it can be readily understood that the northward flowing current of the Gulf Stream, moving as it does with considerable velocity between the Bahama Bank and Florida reef, would cause the water to run into a narrow passage with such force as to cause it to emerge from the opposite opening, especially if this were smaller than the entrance in the sea. To account for the two boiling holes we have only to suppose that they are both entrances to one passage, which would seem plausible, as they are not over a quarter of a mile apart.

Another class of subterranean water ways is a system of smaller passages, through which the water finds its way underneath all the land of the Bahamas, but always at sea level and below it. The evidence that the sea water does so penetrate beneath the land may be found in the fact that the water of the wells, no matter where situated, as far as I have examined them, rises and falls with the tide. To be sure this water is fresh, or but slightly brackish, but it is a well known fact that fresh water will float on salt, as it is lighter. The rain water falling upon the surface of the land finds its way slowly through the more or less porous lime stone until it reaches the level of the underlying sea water, after which it can go no further. Hence all wells, excepting those of which I have spoken, as being Indian wells, and rock holes, in which the surface water is retained for a time, must be sunk to sea level. Thus we find that the well at Fort Charlotte, which stands on the top of a hill, is over ninety feet deep, but other wells, situated in the old lagoon bed, are much shallower, while in the pine woods, where the land is quite low, water occurs within about three feet of the surface.

It is scarcely probable that the sea water thus penetrates to all parts of the underlying strata of the keys by simply percolating through the aeolian lime stone, even though this is softer at considerable depths than on the surface, for the water rises and falls in the wells nearly or quite uniformly with the tides, as regards time, and at extreme low water the wells are dry. This fact renders it probable that there are larger channels through which the water ebbs and flows and that such channels occasionally break out into the light of day in the form of the ocean holes, of which I have spoken.

Another class of underground water ways, with an account of which I shall conclude this article, are the salt springs which exist in all large salinas, like those at Rum Key, Long Island, and Inagua. These salt plains are very nearly on a level with the sea at high water, being at best only a few inches above it. They are as a rule destitute of vegetation, excepting a few peculiar plants which thrive best in a soil largely impregnated with salt.

From these level plains, as I have seen at Inagua, are to be found flowing springs, the water of which is many times salter than that of sea water. The presence of these springs may be accounted for, I think, by the fact that they occur in the neighborhood of large, shallow bodies of salt water, which receive their supply from the sea. either through direct open inlets, or through subterranean agencies. The water spread out in a shallow basin is rapidly evaporated. and thus contains a large percentage of salt. This water finds its way through the porous rock or sand of the surface and emerges as salt springs at points where the land is slightly lower than the general level of the lake. The manufactories of salt on those islands take advantage of the occurence of these salt springs, and by constructing basins where the water from the springs will flow into them. evaporate it until salt is obtained. It is usual, however, to admit a certain porcentage of sea water into these basins, thus considerably increasing the supply of salt.

Pure sea water is, of course, used in places for the manufacture of salt, both by solar and artificial evaporation, but I do not know of any place on the Bahamas where this is done without the assistance of the flowing salt springs.

DEFENSIVE GLANDS IN A BAHAMA SPECIES OF PHASMA.

In closing an article upon the defensive glands of a Florida species of phasma (Anisomorphia buprestoides) in Vol. I of Contributions, I stated, on page 35, that, although I had seen hundreds of an allied species to these insects in the Bahamas. I had never seen them discharge any fluid, but stated that, as they had a peculiar odor. that it was possible that they did possess glands.

At that time and upon a subsequent occasion my observations of the Bahama phasma were made in the winter. at which time I found the insects living in air plants. These air plants at that time contained more or less water, which is retained in the hollows formed by the peculiar curved structure of the base of the leaves. Quite a number of animals take refuge in the air plants, attracted no doubt by the water which is there. I have found a tree frog, two or three species of mollusks, a species of large cockroach and the young of a snake (a Boa). All of these animals were common, excepting the last, which occurred occasionally. Besides these were the phasmas, which were more abundant than all the other animals put together. I collected a large number of these insects at that time, and in my search for the other animals which inhabited the air plants disturbed many others, but none of them emitted any of the peculiar fluid of which I have spoken in the article cited. Of this I am certain, and another reason I had for thinking that they did not possess the power of emitting the fluid was that they formed an important item of food for the Great Bahama Cuckoo (Saurothera bahamensis), in fact, the first specimen of this bird that I ever saw was engaged in searching an air plant for phasmas, and I have frequently seen others so engaged.

These opinions and observations are taken from my notes made during the winters of 1883 and 1888, but upon visiting the Bahamas again in the spring of 1893 I found quite a change in the fauna of the air plants. During the two previous years of my visits there had been considerable rain fall in the Bahamas and consequently the air plants were filled with water, but previous to 1893 there had been but little rain in the islands for nearly three years, and none at all that winter, consequently there was no water in the air plants, and upon examination I found that they contained few or no animals of any kind; the cockroaches still remained and a few spiders were found, but not a single specimen of a phasma.

During the second week in March, however, when searching for shells and insects, under the bark of dead trees in the agava fields to the westward of Nassau, in company with Mr. Curtiss, we discovered a large number of this Anisomorphia. [Note. I regret that at this time I am unable to give the specific name of this insect. but hope to give a figure of the animal in a subsequent volume of Contributions when this omission will be supplied.]

The phasmas were lying under the bark of trees, much as I found the allied Florida species, and were mated. each female being accompanied by a male, which was clinging to her as described in the previous article. But what was of especial interest to me was the fact that both male and female discharged a similar fluid to that observed by me in the Florida species, and which had much the same odor. As in the Florida species, the male discharges his fluid with more reluctance, upon being disturbed, than the female; it being emitttd by her almost as soon as she is exposed to the light by pulling off the bark, while the male usually has to be actually handled before the defensive fluid is thrown off.

The only difference that I could perceive in any of the females as compared with the Florida species, in regard to power of emitting the fluid, was that in some females, in addition to the ejection of the flnid from the regular orifices in direct connection with the glands, small drops issued from the joints of the abdomen on the upper portion of the body.

I made an examination of a number of the specimens which we collected, on March 11, 1893, and found the glands and accompanying apparatus for ejecting the fluid were so nearly similar to those parts in the Florida species already described and figured (See Vol. I, page 31, and Plate III) that, aside from size, the Bahama species being a little smaller, I could see no difference. I was somewhat surprised at this as I fully expected to find some modification which would account for the power of exuding the drops of fluid from the joints of the abdomen. Neither could I discover any additional glands anywhere, although I searched with great care.

The observations made during this last season upon these insects has convinced me of the fact that the phasmas which I observed on previous years in the air plants were all young as they were much smaller than those obtained under bark, hence, in all probability did not possess the power of ejecting the fluid.

As it is now an established fact that these glands exist in three species of members of this genus (Anisomorphia) it becomes evident that their presence offers a strong generic character, if not one upon which a higher group may be founnded.

SOUND-PRODUCING ORGANS OF BIRDS.

(Continued from Page 167, Vol. 1.)

SAUROTHERA BAHAMENSIS.

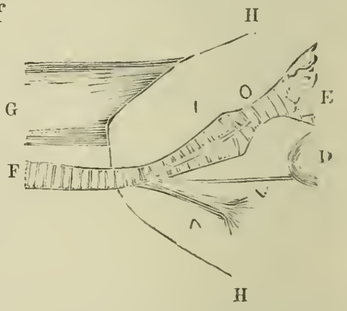
Bahama Cuckoo.

This is a singular bird, evidently one of the remaining species of an old race of Cuckoos. It utters some very singular gutteral notes and I was quite anxious to examine the laryngeal structure. The following notes are made from a male taken Feb. 5th, 1887, in the neighborhood of Nassau.

I found the trachea straight without any special dilitation, and it measured about 2.10 to the inferior laryngeal muscles. The sterno trachealis was present and proportionately well developed, and extended in a straight line to the costal process of the sternum, see fig. 64, V being the sterno trachealis, F, the trachea, and D, the costal process of the sternum. At the point of junction of the sterno trachealis, the trachea is somewhat contracted, and is curved upward. It is held in this curved position by a membrane which adheres to the trachea, and passing backward is fastened to the muscles of the breast on the inside near the inner edge of the furcula. (See ib., V, being the membranous muscle, and H, H, the outlines of the body, while G is the neck.

Immediately after its contraction, the trachea becomes wider, and widens until it merges into the larynx, ib. I. At the junction of the sterno-trachealis with the trachea a narrow broncho-trachealis has its origin, and passing above the sides of the trachea adheres to the fourth half ring of the bronchial tube, being about .60 long. The bronchial tubes (ib., O) are short with about six half rings, are contracted a little at their origin, but expand to enter the lungs. E

FIG. 64.



Inferior larynx of the Bahama Cuckoo. A, membrane muscle : D, costal process of sternum : E, lungs ; F, trachea ; G, neck ; H H, outlines of body : I, Broncho trachealis : O bronchial tube. V, sterno trachealis.

and the gutteral sounds which this bird utters are produced by what little vibrating surface there is on the inside of the bronchial tubes.

The drawing downward of the trachea by the membrane-like muscle, (ib. A) probably has nothing to do with the sound-producing organs, but is thus drawn downward in order to permit the entrance of the large oesophagus between the neck and the larynx. The Bahama Cuckoo subsists largely upon lizards of the genus Anolis, of which there are two or three species on New Providence, which is the home of this fine Cuckoo, and individuals are very abundant. These lizards are swallowed whole, after being killed by a violent shaking. Some of these lizards thus eaten are six or seven inches long, and in passing into the stomach through the oesophagus must occupy considerable room. I kept a Cuckoo of this species in confinement and it would eat six or seven large lizards at a meal, and judging from the size of the stomach, this organ could not have contained one half this number, hence some must have remained in the oesophagus.

MIMOCICHLA PLUMBEA.

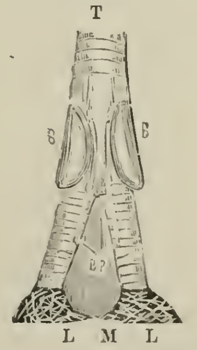
Plumbeous Thrush.

The vocal organs of this bird are among the most remarkable of any that I have seen in the Thrushes.

The trachea is perfectly straight and measures about 1.62 to the inferior larynx, the muscles of which are remarkably well developed, the usual five pairs being present, and a slender sterno-trachealis. All of these muscles are about normal in size and form, excepting the broncho-trachealis posticus: this sends down a long accessory spur as far as the tenth half ring of the bronchial tubes. See fig. 65, T being the trachea; B, B, the broncho-trachealis anticus, and B, P, the broncho-trachealis posticus with the accompanying spurs, extending down on to the bronchial tubes, C. The sterno trachealis is omitted in the figure, which is about life size.

Another remarkable feature, which is, however, present in some other birds is a

FIG. 65.



Inferior larynx of Plumbeous Thrush. T, trachea. B, broncho-trachealis anticus. B, P, broncho-trachealis posticus. C, bronchial tubes, M, membrane between tubes. L, lungs.

membrane which extends completely across from one bronchial tube to the other just above the tympaniform membranes. See ib., M.

The os transversale is present and supports a well developed semiluna membrane, while the tympaniforms are about normal in size.

With such a development of sound-producing organs and their accompanying muscles we should expect to find this thrush a fine singer, and such is the case.

The regular song is loud and clear, something like the syllables "an-cheer" but with the regular double-noted thrush-like intonation, followed by two mellow whistles, and this lay is given repeatedly. These notes are given in May, which is quite near the breeding season, but earlier in February they sing quite differently, reminding one strongly of a Cat Bird or of a Brown Thrush, with some notes of the Robin interwoven.

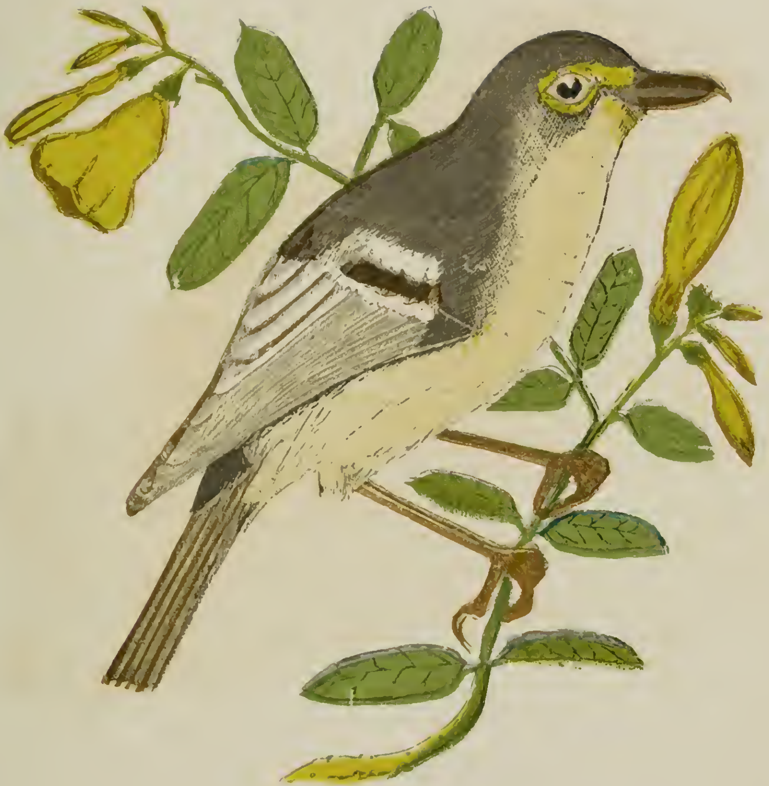
Most of these sounds are, without doubt, produced by the vibration of the semiluna membrane, but we can attribute the other double intonation partly, if not wholly, to the tympaniform.

Nothing in the regular song would account for the peculiar laryngeal modification, which I have described, and I could not understand the function of these organs until I heard the bird mimic first the harsh cry of an Ani, then the peculiar "bob-white" of the Quail, executing both with such exactness as at first to completely deceive me.

If we conclude that, as a rule, all of the organs, or modifications of organs, especially if modified to an unusual degree, are of benefit to the animal possessing them, it is rather difficult to thus account for the presence of these singular laryngeal modifications in the larynx of the Plumbeous Thrush. As seen, they doubtlessly assist it to utter harsher cries than it could otherwise give, but just what benefit such cries are to the bird I cannot readily understand. The birds which I have heard uttering them did not appear to be at all alarmed at anything (and, in fact, the regular alarm note is not unlike that of a Wood Thrush), and consequently could not be trying to intimidate an enemy by imitating the cries of a larger bird.

It was with considerable interest that I examined the larynx of a closely-allied species, the Red-legged Thrush, M. rubripes, which I found on Cayman Brac, and a description of the laryngeal muscles of this species I give below.

PLATE XII.



THICK-BILLED VIREO.
Life size. Type form. Adult male.
Nassau. April 1883.

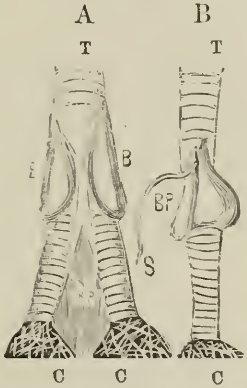
MIMOCICHLA RUBRIPES.

Red-legged Thrush.

The trachea in this species is straight, but is a little flattened and measures about 2 10 to the inferior larynx.

The laryngeal muscles are as in the Plumbeous Thrush in number and general form, but in this species the upper portion of the broncho-trachealis anticus is produced upward into a point, whereas in the allied species it is somewhat truncated. See fig. 65, B, B, and compare with fig. 66, A, B, where I have given an enlarged figure of the larynx of the Red-legged Thrush. As seen in this figure also, the elongated spur of the bronchio trachialis anticus is also present, but it is not quite as prominent as in the Plumbeous Thrush, but extends over the same number of half rings. The membrane between the tubes is also present in this species. See ib., M; C, C, being the bronchial tubes, and L, L, the lungs. At B, I have given a side view of the larynx, in which is shown the origin of the thin sterno-trachealis between the divisions of the broncho-trachealis. In this species the tympaniforms are present, extending the entire length of the bronchial tubes, and the os transversale also supports a well developed semiluna membrane. There are fourteen half rings in the bronchial tubes which is about the same number as in the Plumbeous Thrush.

FIG. 66.



Inferior larynx of Red-legged Thrush. A, front, B, side view. T, trachea, B, broncho-trachealis anticus; D, b. t. posticus; C, bronchial tubes; M, connecting membrane: G, sterno-trachealis.

The song of the Red-legged Thrush differs considerably from that of the Plumbrous Thrush, but with a general resemblance which proclaims the affinity of the two species. Although I did not hear the Red-legged Thrush mimic the Ani, nor any other bird, I did hear them utter some very harsh notes. The first time that I heard their notes was on March 31st, 1888, when I was seated beneath a wild fig tree watching the birds which were feeding upon the fruit, which was then ripe, and these thrushes frequently visited the tree. Several came into the tree quite silently, when one came in and, without perceiving me, gave several harsh cries, which were quite different from any I had heard emitted by the Plumbeous Thrush. I also heard these notes given afterwards, when I was visiting the elevated plateau on the eastern end of Cayman Brac, where the species is not numerous.

Nothing, as seen, which I have observed in this last-mentioned Thrush, would serve to throw any light upon the probable origin of the singular spur of the broncho trachealis anticus nor why it should now exist in both these species, for I can see no reason why the harsh notes, which this spur enables them to utter, is of any benefit to them, any more than would similar notes be of benefit to, for example, a Wood Thrush. The only possible reason that I can give for its presence is that it may be an inherited character, but upon this point we need more light, which can only be furnished by further investigation among tropic thrushes. I may here say that the only other member of a strictly tropical genus of thrushes that I have examined is a Magrops, M. fuscata, taken at Inagua, and in this I did not find even an approach to a spur on the broncho trachealis anticus, the larynx being about normal.

ZENAIDA AMABALIS.

Zeniada Dove.

This dove possesses one of the most singular sound-producing apparatus that I have ever seen.

The trachea is straight, some 3.50 long, is cylindrical on its upper portion, but is slightly flattened as it approaches the inferior larynx. The most marked peculiarity in the trachea is a hollow, which, beginning by a slight depression, increases in width and depth gradually, until it approaches the larynx, when it becomes gradually smaller. The walls of this depression are very thin and may possibly serve as a vibrating membrane. See fig. 67, A, A where I give a life-sized figure of the upper side of the trachea, showing this peculiarity.

The sterno trachealis arises about .30 above the larynx and is quite well developed. Besides this on either side arises a thin, narrow strip, evidently the remains of a broncho trachealis. These muscles extend over about eight rings of the trachea and then extend over the long larynx near the lower side.

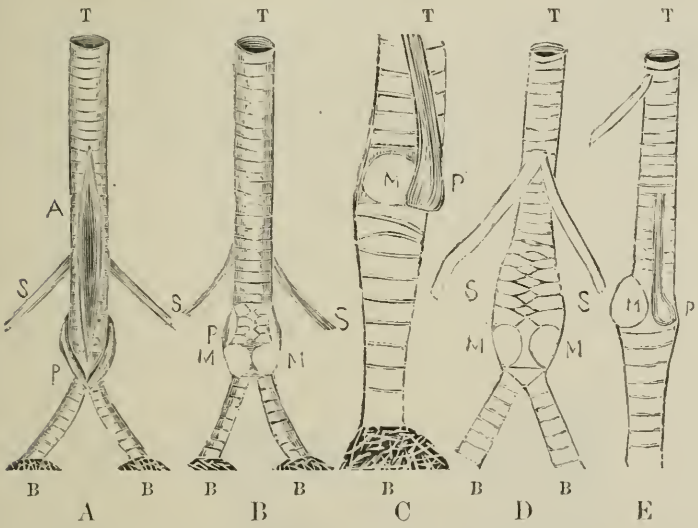
In the long larynx is a nearly circular orifice, about .12 in diameter, across which stretches a thin, nearly transparent membrane to the side of which the broncho trachealis is attached. See ib., B, M, being the membrane. At C, I have given an enlarged view of this membrane, lettered as at B.

The bronchial tubes are rather thin, with nine half rings, and with a normally-developed tympaniform membrane.

This dove, as might be expected from such a musical apparatus, has a singular note. The male perches upon a limb of a tree, swells out his throat and utters his cooing song which he repeats at rather regular, but protracted, intervals.

This song begins with two notes, the first uttered with a falling inflection, the second with a rising. The second follows the first rather quickly, and is not as prolonged. Both are in a low key. Then follows three other notes, sounding like "Who, who, who," but there is a decided pause between the first two: the last three are given in the same time and in the same key. The notes are all loud, but when softened by distance have a singularly mournful effect.

FIG. 67.



Illustrating the inferior larynx of the Bahama and Cayman Zanaida Doves. A, B, C, Bahama; D, E, Cayman. A, hollow in trachea; S, sterno trachealis; P, broncho trachealis; M, vibrating membrane; B, bronchial tubes; T, trachea, in all figures.

Zenaida richardsoni.
Cayman Dove.

On the islands of Cayman Brac and Little Cayman I encountered a dove which closely resembles the Zanaida and which coos in much the same manner, but which differs somewhat in the laryngeal structure.

The hollow is present in the trachea above, much as in Z. amabalis, but the trachea is a little wider. See fig. 67, D, where I give a species and those given by Z. amabalis. The Cayman Doves were exceedingly tame and I have frequently watched them feeding within a yard of my feet.
slightly-enlarged view of this side of the trachea, the lettering being the same as in Z. amabalis in all the figures.

The sterno-trachealis has a peculiar origin, as both branches of it emerge from one point close together on the lower side of the trachea. See ib., D, s. The broncho trachealis is slightly enlarged at the end near the membrane in the lower larynx and this membrane is rather more oval in form than in the allied species. See ib., D and E, m.

There are eight half rings to the bronchial tubes, and the tympaniform membrane extends its entire length.

In spite of this variation in the form of the sound-producing organs I could not perceive any difference in the notes uttered by this

INDEX.

Abnormal growths of V. fistularis, 60
Acorn Strophia, 156
Aegialitis wilsonias, 34
Agava Strophia, 152
Aplysina fistularis, 55
" gigantea, skeleton of, 57
Approximate length of life of the Blue Bird, 104
Attacus polyphemus, 36

Bahama Cuckoo, 194
Bahama Islands, Subterranean water ways in, 182
Beaver urchin, 43
Biscuit urchin, 42
Birds, Sound-producing organs of, 194
Black Tube Sponge, 85
" spined urchin, 46
Blue Bird, Approximate length of life of, 104
Brown Tube Sponge, 85
Bud propagation of V. fistularis, 59
" variation of V. fistularis, 60

Cayman Dove, 187
Changing Strophia, 125
Choice Strophia, 177
Chrysalis of Polyphemus Moth, 37
Cidaris tribulorides, 38
Cinerous Strophia, 119
Closing membrane of V. fistularis, 60
Club-spined urchin, 38
Conch shells, method of opening, 26
Conclusions and Summary of V. fistularis, 81
Comparisons of Allied Species of V. fistularis, 77
Cory's Strophia, 129
Curtiss' Strophia, 107
Cushion Urchin, 44

Defensive glands in a Bahama species of Phasma, 191
Diadema setosum, 46
Distribution, Habits and, of V. fistularis, 75
Double-margined Strophia, 164
Doubtful species of Verongia, 79
Dwarf Tube Sponge, 86

Echinanthus rosacea, 42
Echinometia subangularis, 40

Fiber of Orange Tube Sponge, 73
Field Fetiches, 18
Filament of V. fistularis, 65
Filament of V. insularis, 65
Filamentos Sponge, 87
Folk law among the West Indies, 1
Ft. Charlotte Strophia, 154

Gigantic Strophia, 141
Goat Key, 172
Grass Strophia, 179
Gray Acorn Strophia, 159

Gray's Strophia, 138

Habits and Distribution of V. fistularis, 75
Habits of V. fistularis, 78
Head of Adalt Wilson's Plover, 35
Hipponoe esculenta, 39

Indian axe, 31
" wells, 26
Ivory Strophia, 144

Large-billed Vireo, 92
Long Strophia, 148
Lucayan Indians, Traces of in the Bahamas, 23
Luffaria fistularis, 55

Mimocichla plumbea, 195
Mimocichla rubripes, 197
Meoma ventricosa, 43
Metalia pectoralis, 44
Methods of opening Conch shells, 26
Monograph of the Genus Strophia, 107
Mottled Strophia, 123

Neglected Strophia, 150
Notes on a singular specimen of Attacus polyphemus, 36
Notes on West Indian Birds, 92
" " " " Sea Urchins, 31
" " Young Birds, 34

Observations.Variations and, on V. fistularis, 63
Orange Tube Sponge, 55
Organs, Sound-producing, of Birds, 194
Oval Urchins, 40
Ovaries of a Blue Bird, 105

Parasites of V. fistularis, 80
Pilsbry's Mottled Strophia, 173
Pilsbry's Strophia, 170
Pink Strophia, 128
Phasma, Defensive Glands in a Bahama species of, 191
Plumbeous Thrush, 195
Polyphemus Moth, 36

Red-legged Thrush, 197
Regular Strophia, 135
Restricted Strophia, 175
Rigid Sponge, 83
Ritchie's Strophia, 135
Robust " 121

Saurothera bahamensis, 194
Short Strophia, 143
Sialia sialis, 104
Skeleton of V. insularis, 89
" " " fistularis, 68
Snowy Strophia, 112
Small Tube Sponge, 83
Sound-producing organs of birds, 174
Sponge, Orange Tube, 55
Spongia fistularis, 55
Sponges, Studies of North American, 47
Strophia agrestina, 179
" albea, 128
" bimarginata, 164
" " cera, 168
" carlotta, 154
" cinerea, 119
" " mutata, 125
" " robusta, 121
" " tracta, 123
" coryi, 129
" curtissii, 107
" " nivia, 112
" elongata, 148
" eburnia, 144
" eximea, 177
" glans, 156
" " grisea, 159
" grayi, 138
" " gigantea, 141
" " pumilla, 143
" Monograph of, 107
" neglecta, 150

Strophia neglecta agava, 152
" pilsbryi, 170
" " evolva, 173
" restricta, 175
" ritchiei, 135
" regula, 161
" thorndikei, 116
Studies of North American sponges, 47
Subterranean water ways of the Bahama Islands, 182

Thorndike's Strophia, 116
Toxopneustes variegatus, 40
Traces of the Lucayan Indians in the Bahamas, 23
Tube Sponge, fig. of 48

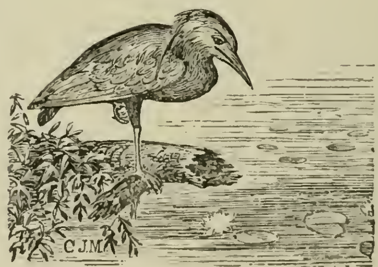
U, Key, Diagram of, 13

Variable urchin, 40
Variations, Observation of, V. fistularis, 63
Verongia applicata, 85
" doubtful species of,
Verongia fistularis, 55
Verongia, fistularis, fig. of, 48
" " filament of, 65
" insularis, 85
" rigida, 83
" rupicola, 35
" sebae, 85
" The Genus, 52
Vireo crassirostris, 92

Water system of Verongia fistularis, 56
Water system of Verongia insularis, 89
Waxy Strophia, 168
West Indian Birds, Notes on, 92
" " Sea Urchins, Notes on, 38
White-Spined Sea Urchins, 39
Wilson's Plover, 34

Young of V. fistularis, 64
" " Wilson's plover, 35

Zanaida amabalis, 198
Zanaida Dove, 198
Zanaida richardsoni 199



CONTRIBUTIONS TO SCIENCE

BY

CHARLES J. MAYNARD.

ILLUSTRATED WITH HAND COLORED PLATES AND WOOD CUTS

Vol. III. [illegible] No. 1

NEWTONVILLE, MASS.

CONTRIBUTIONS TO SCIENCE.

BY

CHARLES J. MAYNARD.

Volume Three. March, 1896.

MONOGRAPH OF THE GENUS STROPHIA.

(Continued from Vol. II, page 182,)

The first portion of the present instalment of this monograph is based upon specimens belonging to the Museum of Comparative Zoology, Cambridge, Mass., where I have been permitted to examine them through the kindness of Prof. Alaxander Agassiz, with a view of determining the species; I have returned the types figured to the Museum, but have retained a set of co-types in my own collection. I wish also to thank Dr. Walter Faxon for valuable assistance in many ways in preparing this paper.

55. STROPHIA CHRYSALIS Ferussac.

Chrysalis Strophia.

Plate I, fig. 1, front view, fig. 2, side view of typical specimen.

Ferussac, Hist. Nat. Moll. 1820-1851, Vol. II, page 205. Plate 153, figs. 1 and 2 (not fig. 7, nor figs. 7 and 8 plate 156) .

DESCRIPTION.

Sp. Ch. Size, rather large. Shell, moderately thick and heavy. Striations, present. Whirls, 11. Examined 11 specimens.

Form of shell, a long pointed cylinder, with the first, second and third whirls equal in diameter, then the shell slopes to a semi-obtuse point which forms an angle of forty-three degrees. The striations are not numerous, there being fifteen only to the first whirl, not very prominent, rather irregular, are slightly bowed in the middle of the whirls toward the right, and they are also slightly inclined from right to left, are narrow, and the interspaces are thus about twice as wide as the prominences. The striations are not furrowed, but are smoothly rounded and polished. The whirls are not bulging and the suture is shallow.

Aperture, large and widely open measuring considerably less within than at the entrance. The lower tooth is very small, about .07 long and is about one half as high as long, its position is about central, but it is set back about twice its length from the frontal bar. The upper tooth is about the same height as the lower, but extends backward around the column.

The margin is not produced forward beyond the diameter of the shell, but is considerably inclined to the right, quite beyond the side, is not thickened (measuring .04 only) but is reflexed outward at least .10, with the edge rolled over and smoothly rounded. The frontal bar is rather indistinct, is well inclined to the right, as the striations appear within it as distinct ridges which continue to appear as far down as they can be seen from the entrance.

Color of shell externally, yellowish white, quite prominently marked with a rather pale yellowish brown which is inclined to form longitudinal patches between the striations. These patches are quite frequently encroached upon by the white along their sides, hence their edges have an undulating or serrated appearance. In some cases the patches are broken quite across by the encroaching white, then the brown appears as a series of thick horizontal lines one above the other. Internally brown, paler than the external markings. This color pales into yellowish white on the tooth and margin.

DIMENSIONS.

Size of typical specimen, 1.35 by .45. Largest specimen, 1.37 by 47; smallest, 1.25 by .41. Longest specimen 1.35; shortest, 1.25. Greatest diameter, .47 ; smallest, .41.

OBSERVATIONS.

The tendency among the specimens examined is to produce on one hand a rather more slender form than the type with the angle of the apex more acute, and on the other, a proportionally shorter, stouter form, measuring, about 1.20 long; rather more highly ornamented with brown markings.

This beautiful species can be readily distinguished by the large size, always over 1.25 long, open mouth with the flanging margin, the prominent striations within, which even appear on the upper wall, and the singular, broken, pale brown markings, which recall those of Strophia mumia.

I found these shells in the Museum collection bearing the simple label "Havanna Cuba". Beyond all doubt, this is the principal species which Ferussac had in hand when he described his Pupa chrysalis in the work cited at the head of this article, as his description clearly indicates, while his excellent figure, although the markings are a little darker in color, coincides almost exactly with the specimen which I have considered typical and figured on plate I. Owing to the broad interpretation of what constituted specific characters which prevailed in his time, Ferussac included two quite different shells in his plates as this species, namely fig. 7 on plate 153, and 7 – 8 on plate 156, but what these are, I have not yet determined. Thus the localities given by Ferussac, other than Cuba (Guadaloupe and Martinique) are probably those of the other species figured. The size of Ferussac's type is given by him as 35 mill. long by 13 mill. in diameter. Below I have given his diagnosis in the original Latin accompanied by a translation.

"P. testa elongata, turrita, cylindrica, apice obtusa, longitudinaliter plicata, grisea, lineis fuscis angulatis ornata; apertura ovato-rotunda, intus fulva, marginata, unidentata."

This may be translated as follows. Shell elongated, turreted cylindrical, apex obtuse, longitudinally striated, gray, ornamented with narrow, dark lines, aperture, round ovate, fulvus inside, margined, one-toothed.

56. STROPHIA SCRIPTA. Novo.

Inscribed Strophia.

Plate I fig. 3, front, fig. 4, side view of type.

DESCRIPTION.

Sp. Ch. Size about medium, shell rather thick and heavy. Striations, present. Whirls, 11. Examined 29 specimens.

Form of shell a pointed cylinder, the first whirl being the largest, then each successsive whirl is a little smaller to the fourth, from which the shell tapers more suddenly to a semi-obtuse point, forming an angle of fifty degrees. The striations are moderately numerous, twenty to the first whirl, but they are not very prominent. Are quite regular, but not arranged in lines. They are rather straight being curved slightly to the right at their lower terminations, and are slightly inclined from right to left. They are not furrowed, but rounded and polished, and the interspaces between them are twice their width. The aperture is not especially large, measuring but a little more within than at the entrance. Both teeth are represented by a mere tubercle scarcely to be seen even with the aid of a magnifying glass.

Margin, not produced forward as far as the diameter of the shell. It is very slightly inclined to the right, but not beyond the side of the shell. It is exceedingly thin, measuring rather less than .02, is only slightly flanging, being extended outward about .04, it is not rolled over and the edge is only slightly rounded. The frontal bar is very slightly indicated, consequently the striations pass with very little diminution of size directly into the interior of the shell, and a sectionized specimen shows that they continue quite to the apex.

Color of shell externally bluish white, beautifully marked with rather longitudinal patches of deep purplish brown which often overlie the striations as well as the interspaces between them. These brown marks are encroached upon on either side by alternating lines of white which often penetrates nearly through this brown causing it to appear like pen markings made with brown ink. This semblance is heightened by the fact that the brown lines are not often broken through. Internally the color is rather deep purplish brown, paler on the margin.

DIMENSIONS.

Size of type, 1.30 by .47. Longest specimen 1.30 by .50; smallest, 1.05 by .35 ; greatest diameter, .50, smallest, .35 ; longest specimen, 1.30; shortest, 1.05.

OBSERVATIONS.

Variation consists in a tendency to produce a stouter form with the first three whirls equal, and also a form with less fleckings.

Form No. 1. In addition to these varieties which must be considered as simply individual, there is a well established form which consists of about twenty percent of the whole examined. These are smaller, shorter shells with 10 whirls, size, 1.05 by .35. The form and markings are similar to the type form. This fine species was labled "Pupa chrysalis" in the collection, but differs in several important particulars from that species. It is smaller, with a smaller aperture which has a margin that is scarcely flanging at all, the teeth are much smaller, while the fleckings are much darker and are not as much broken into horizontal lines and the shell is more pointed.

These shells were labled as coming from "Cardenus, Cuba, Andros M. de Cisneros [collector] received Jan. 14, 1878."

STROPHIA SCRIPTA OBLITERATA Novo.

Pale Strophia.

Plate I, fig. 5, front, fig. 6, side view of type.

DESCRIPTION.

Sub Sp. Ch. Size, small, shell, rather thick and heavy, striations present, whirls, 10, examined 102 specimens.

Form of shell, a pointed cylinder with the first whirl the largest, the second, third and fourth are successively a little smaller, then the shell tapers to a rather obtuse point, forming an angle of about sixty-three degrees. The striations are few, fifteen to the first whirl. They are quite prominent, rather irregular, quite straight, but not arranged in lines. They are not furrowed, but are smoothly rounded and polished.

Aperture, rather small, slightly contracted within. Both teeth are represented by a mere tubercle.

Margin produced forward about as far as the diameter of the shell and is scarcely inclined to the right. The margin is only slightly flanging and is not rolled over, while the edge is slightly rounded. The frontal bar is quite well developed, but the striations appear within it as quite prominent ridges which extend into the shell quite to the apex, as shown in a sectionized specimen.

Color of shell, ashy white externally, rather sparingly marked with longitudinal patches of inconspicuous pale reddish brown. These patches are frequently broken into transverse lines by the encroachment of the white. Within, yellowish brown which becomes paler on the margin.

DIMENSIONS.

Size of type 1.08 by .40. Longest specimen, 1.13 by .43. Smallest 1.00 by .30. Greatest diameter .43, smallest, .30. Longest specimen, 1.13, shortest, 1.00.

OBSERVATIONS.

There appear to be a number of quite distinct forms.

No. 1 is without markings, being pure white, and as is usual in similar cases, where a white form has become evolved from a colored one, the shell is thinner, with a consequent less development of frontal bar. The average size is a little smaller, but the form is similar. There are about ten per cent of this form.

No 2. Smaller than the type, proportionately stouter, with nine whirls, otherwise similar. There are about seventy per cent of this form in the collection, but as the form described as typical, approaches nearest to the true S. scripta, I have considered it as the type of the sub-species.

No. 3. More cylindrical than the type, with the first three whirls about equal in diameter and the shell is more slender, measuring about .30 in diameter. Whirls, 10. There are about seven per cent of this form.

No. 4. A beautiful color form of a rich reddish or purplish brown throughout with delicate horizontal lines of white. This may prove to be a well marked sub-species, but as I have two specimens only give it as a form.

No. 5. White in color, with few or no fleckings and with the upper whirl somewhat larger than the second. There are eight per cent of this form.

This sub-species, which after all may prove not to intergrade with S. scripta, may be readily distinguished from it by the smaller size and from the often nearly obliterated markings. These were also labeled "P. chrysalis" followed by the more valuable application of "Matanzas Cuba, rocks close to the sea." Judging from the maps, Matanzas is distant some twenty miles from Cardenas, the home of the true S. scripta. Although both forms may spread over a large area, and thus intergrade at some point on the coast, this is quite improbable and as intimated above, the two may prove quite distinct.

53 STROPHIA FASTIGATA Nova.

Tapering Strophia.

Plate II fig. 1, front, fig. 2, side view of type.

DESCRIPTION.

Sp. Ch. Size, medium. Shell quite thick. Striations, present. Whirls, 10. Examined 62 specimens.

Form of shell, a pointed cylinder with the first whirl the largest, the next four are each successively a little smaller, then the shell slopes abruptly to a somewhat obtuse point, forming an angle of sixty-two degrees. There are nineteen striations on the first whirl, not very prominent, not very regular, and not arranged in lines. They are not furrowed on top, but are smoothly rounded and polished.

Aperture about as high as wide rather large and open, being considerably wider at the entrance than further within. Lower tooth small about .04 long by .02 high. It is about central in position, and is placed far back in the shell at about three times its length from the frontal bar. The upper tooth is about the same height as the lower.

Margin, not produced forward as far as the diameter of the shell, is very slightly inclined to the right and a little beyond the side, but is extended outward about .05 and slightly rolled backward and the edge is rounded. The frontal bar is quite well developed, is somewhat obliquely inclined and almost completely interrupts the striations which are slightly indicated only within.

Color of shell, externally, white without markings; internally, pale yellowish brown, fading into white on the margin.

DIMENSIONS.

Size of type 1.20 by .40. Largest specimen, 1.25 by .42; smallest, 1.10 by .35. Longest; 1.20: shortest, 1.10.

OBSERVATIONS.

Young specimens with the margin fully form ed, but in which the frontal bar is not fully developed, do not have the teeth. There is very little individual variation, some shells being a little more obtuse than the type, but there is a form as given below.

Form No. 1 with fewer striations, these being mainly absent on all but the upper three whirls, where they are finer and more numerous, about 28 to the first whirl. There is in many instances in this form a distinct double lower tooth. There is also an inclination in some specimens of the type form to assume a double lower tooth.

This species may be distinguished by the rather large aperture, pointed cylindrical form of the shell, comparatively small size and white, unflecked color.

This species I found in the collection in the same tray with the shells which I have named S. scripta obliterata, therefore it is to be presumed that they came from Matanzas, Cuba, but as all of the shells of S. fastigata are deeply stained with a red earth of which those of S. s. obliterata bear no trace, it is evident that they did not come from the "rocks close to the sea" as did the others, but probably from some neighboring field. They were also labled "Pupa chrysalis. Another lot was labeled "Punte Goade, Matanzas, Pupa infanda," and still another lot "Chorrea, Pupa mumia."

59 STROPHIA EURYSTOMA Novo.

Wide-mouthed Strophia,

Plate II fig. 3, front, fig. 4, side view of type.

DESCRIPTION.

Sp. Ch. Size rather large, shell quite thick and heavy. Striations, present. Whirls, 11. Examined 21 specimens. Form of shell pointed cylinder, with the first and second whirls the largest, then the third whirl is a little smaller, and from this, the shell slopes gradually to a point, forming an angle of fifty-five degrees. There are sixteen striations to the first whirl; they are not prominent, are rather irregular, not arranged in lines, nor furrowed, but rounded and polished, are narrow, the interspaces being twice as wide as they, and slightly inclined from left to right.

Aperture large and open, about as wide as high, not at all contracted at the entrance. The lower tooth is small, about .07 long, and about half as high as long; it is set well back about twice its length from the frontal bar; it is about central in position. The upper tooth is about the same height but extends backward around the column.

Margin not produced forward beyond the diameter of the shell, but is somewhat inclined to the right beyond the side of shell. It is thin, (about .03) considerably flanging, projecting outward about .10, and somewhat rolled over, but the edge is smooth. The frontal bar is not well developed and the striations appear quite prominently within it, extending backward into the shell.

DIMENSIONS.

Size of typical specimen, 1.35 by .40. Largest specimen, 1.36 by .47; smallest, 1.27 by .35. Greatest diameter, .48; smallest, 35. Longest specimen, 1.38; shortest, 1.25.

OBSERVATIONS.

There is some individual variation in the inclination of the margin; some specimens having this about straight. There is one developed form.

Form No. 1. More slender in form, and rather more acutely pointed, and while the striations are more numerous above, twenty-five to the first whirl, they are nearly or quite absent on the lower whirls. I found two of this form in the museum collection, but I find that out of seven shells received from another source, also labeled Havanna, that all, with a single exception, are of this form. Thus it may be possible that this will prove to be a sub-species, inhabiting a locality apart from the typical form.

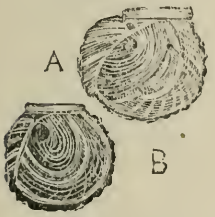
This species may be distinguished from all of the other flanging-mouthed Cuban shells, yet mentioned, by the open mouth, large size, and white, unflecked color. For comparison with S. infanda of Shuttleworth, see that species.

I found these shells bearing the label "Pupa mumia, Havanna Cuba."

The color of the shell of S. eurystoma is yellowish white, externally, with the apex flesh color. Internally, pale brownish or flesh, fading into yellowish white on the teeth and margin. It is worthy of note that shells of the typical form, show stainings of a red ochraceous earth, while those which I have mentioned as form No. 1, are either stained with a brown earth or are without staining, hence it is reasonable to suppose the forms do not occur together. Should this prove true, form No. 1 must take subspecific rank, in which case it may be called Strophia eurystoma ignota.

SUBGENUS 7. TRIDENTISTROPHIA.

Lower tooth central, elongated, being at least three times as long as high. Behind this are two other teeth which extend back into the shell, but no further than one-half the length of the first whirl. Type, Strophia striatella Ferussac, Habitat, Cuba.



A, tooth of a Tridentistrophia. B, tooth of Diacerion, both enlarged.

This singular system of teeth recalls the channeled tooth of Diacerion, but differs in not extending as far back into the shell, and in having three distinct teeth, the outer of which is shorter than the inner, and often not being longer than the middle or front tooth. See Fig. 1, A, where I have given a cut of the teeth of Tridentistrophia (S. striatella) and compare with ib B, where I have given a figure of the channeled tooth of Diacerion. Other characters of Tridentistrophia are, striations numerous (30 or 40 to the first whirl); margin, thick and rounded never beveled; shell, less than three times its width in length; whirls, short, but the upper is as wide as at least all of the next six following.

60 STROPHIA STRIATELLA Ferussac.

Striped Strophia.

Plate II, fig. 5, front, fig. 6, side view of type.

Pupa striatella Ferussac, Hist. Nat. des Moll. Page 206, plate 159, fig. 11 and 13; 1820–1851.

DESCRIPTION.

Sp. Ch. Size small; shell quite thick. Whirls 6. Examined 25 specimens.

Form of shell, oblong ovate, with the first and second whirls about equal in diameter, then the shell slopes to a semi-obtuse point. The striations are numerous, forty-one to the first whirl. They are narrow, not wider than the interspaces, furrowed, straight, and a little inclined to the right.

Aperture, nearly circular, this is about as wide as it is high. It is small, somewhat contracted at the entrance and measures a little more within than at the outer edge. The lower tooth is .12 long by ·03 high, is about central in position and is set back about .16 from the frontal bar. Both the teeth behind this are about the same sizes as the central, but from its position the outer is longer than the inner. The upper tooth is about as high as the central and extends back around the column.

Margin, not produced forward quite as far as the diameter of the shell, is considerably inclined to the left, beyond the side. It is somewhat thickened, measuring .05, is rolled over and rounded, slightly furrowed and polished, but is not flanging, there being a slight depression only behind it. The frontal bar is well developed, completely interrupting the striations, which, although they do not appear within it as prominences, may be seen through the opaque covering of the mouth.

Color of shell externally, shining white, mottled irregularly with rather longitudinal patches of pale reddish brown; internally, pale brown becoming whiter on the teeth and margin.

DIMENSIONS.

Size of typical specimen .75 by .35. Largest specimen .85 by .45; smallest, .65 by .32. Longest specimen .85; shortest, .65. Longest diameter, .45; smallest, .30.

OBSERVATIONS.

There is but little important individual variation in the specimens examined, aside from size. The two back teeth vary a little, and one specimen of which I have made a section, has the inner much shorter than the outer. Another has one well defined tooth in the beginning of the second whirl, and another slightly developed in front of it.

There can be no doubt but what this is the species which Ferussac had in hand when he described his Pupa striatella, for he clearly states that the teeth are prolonged back into the interior of the shell, as may be seen by his decsription given below, taken from his work cited at the head of this article. I have selected as a type a shell which closely agrees with his figure and dimensions given, namely, 20 mill. long by 9 mill. wide.

Following is Ferussac's diagnosis in Latin of which I also give a translation.

"P. testa profunde rimata, oblongo-ovata, solida, candida, strigis sparsis longitudinalibus fuscis, interruptis, ornata, confertim costata; costis filiformibus, rectis; spira apice obtuse conica, laevigata, pallide cornea; anfractibus novem ad decem planiusculi, angusti, ultimus, antice ascendens, basi vix compressus; apertura semiovalis, intus alba vel fulvida, dentibus duobus profundis altero in pariete aperturali, altero ad columellam, coarctata; peristomata, subincrassatum, brevissime reflexum, marginibus callo junctis, columellari patente."

Shell profoundly rimate oblong oval, solid, white, ornamented with a few interrupted lines of fuscous, ribs near together, thread like and straight. Apex of spire obtuse, very smooth, pale brown. Whirls, 9 and 10, evenly following one another, narrow, the first ascending in front with the last but little compressed. Aperture, semioval, white or a little yellow within. Teeth, two, one deep in the fold of the aperture, also another one on the column. Peristome, thick, short and reflexed, closely joined to the margin. Column, open.

On the next page he also speaks of one tooth which is prolonged into the interior of the shell, his exact words being as follows.

"Plus bas s'eleve une dent interieure, s'appuynt sur l'avant-dernier tour, et se prolongeant assez loin dans l'interieur de la coquille."

I found the shells in the museum collection correctly labeled Pupa striatella, Cabo Cruz, Cuba, the label being in the handwriting of Rafael Arango, who collected many of the Strophias in the museum.

In another large lot of shells of this species examined, I find that in a number of specimens the inner of the two back teeth is greatly reduced in size sometimes not being longer than the outer. I also find that there is a well developed form as given below.

Form No. 1, smaller than the type, measuring .60 by .30, with eight whirls only. Color and form similar to that of the type. There are about six per cent of this form. I have a single specimen in my collection which is in every way similar to typical S. striatella, but which differs in having smaller teeth and in being pure white in color, without markings.

61 STROPHIA MARMORATA Pfeiffer.

Marbled Strophia.

Plate III, fig. 1, front, fig. 2, side view of a typical specimen.

Pupa marmorata Pfeiffer, Zeitschr., f. Mal. p. 83, 1847. et. Helic. Viv., Vol. II, 1848, p. 323.

DESCRIPTION.

Sp. Ch. Size, medium. Shell rather heavy. Striations present. Whirls 9, the upper, of which, with the margin, considerably exceeds in length all of the others put together. Examined 40 specimens.

Form of shell, an obtusely pointed cylinder, with the first and second whirls about equal in diameter, the third is a little smaller and from this the shell slopes to an obtuse point, forming an angle of about sixty-five degrees.

The striations are numerous, about forty to the first whirl, are not prominent, are rounded and slightly widened: they are about as wide-as the interspaces between them, are rather regular, straight and inclined a little from right to left. The whirls are slightly bulging, but the suture between them is shallow.

Aperature, quite large and widely open not at all contracted within and is somewhat higher than wide. The lower tooth is small, about .04 high, and about twice as long as high. It is inclined to be double, the second tooth appearing as a wide mass to the left, but extends backward rather farther than the true tooth. The lower tooth is placed a little to the right of the centre and well within the mouth, about twice its length from the frontal bar. The upper tooth is about as high as the lower, but is thinner and extends back around the column. It is placed quite high on the column and somewhat back of the outer termination of the lower.

The margin is not produced forward beyond the diameter of the shell, and is inclined backward at the top, and slightly to the right, a little beyond the diameter of the shell; it is thin, measuring not over .03 is reflexed outward about .08, is rolled over a little, and the edge, although prominent, is not sharpened, but smoothly rounded. The frontal bar is quite well developed, but is not produced outward beyond the diameter of the shell and is slightly inclined; it completely interrupts the striations, which do not appear within it.

Color of shell, externally, white, marked with longitudinal spots of a rather pale yellowish brown; these markings being seldom broken into horizontal lines by the encroachment of white; internally, pale yellowish brown, fading into white on the teeth and margin. The markings are thicker and rather more regular on the spiral whirls.

DIMENSIONS.

Size of typical specimen .90 by .42. Largest specimen, 1.21 by 50; smallest, .90 by .40. Longest, 1.21; shortest, .80. Greatest diameter, .50; shortest, .40.

OBSERVATIONS.

There is little varation among the specimens examined other than is due to age or to mere varieties in markings. There is, however, one well marked form as given below. Form No. 1, larger, measuring 1.15 by .50. The form is a little more cylinderical than the type, the first three whirls being equal in diameter, the color is similar, but the tooth is larger, being at least three times its height in length, and is also inclined to be double. There are about ten per cent of this form.

There can be no question but what this is the shell which Pfeiffer had in hand when he described his Pupa marmorata in his works cited at the head of this article, as color, form, size, etc indicate. Below, I give the original description and a translation.

"T. rimata-pefrorata, subcylindraceo-ovata, solida, striatula nitidi, nivea, flammis longitudinalibus castaneis, diaphanis ornata, spira sursum attenuata, apice obtusa; anf. 10 subplanulata, ultimus autice plicatus; columnella obsolete et profunde unidentata plica parietis aperturalis mediocris, profunda; apertura semiovalis, intus livido-fusca; perist, incrassatum, reflexum, marginibus superne convergentibus —Long, 24, diam. vix 10 mills. ap. 9 mill. longa, 8 lata (Coll. Philipp.).

Obs. Differt a praecedenta colore, apertura lateore, dente parietis aperturalis obsoletiore, dente columellari minimo, etc."

Shell rimate and perforated, sub-cylindrical ovate, solid, striated shining white, ornamented with longitudinal, transparent, flames of chestnut, which are alternate on the spire. Spire obtuse; whirls, ten, sub-even. The last plicated in front; column obscurely and deeply one-toothed, pariatal fold of the aperture, deep. Aperture, semioval livid fuscous within. Peristome, not thickened, reflexed. Margin, partly converging. Length, 24 mill. diameter, 10 mill. Aperture 9 mill. long 8, wide. (Collection of Phillip.).

Observation; differs from the preceeding, in the color, width of aperture, smaller tooth in aperture, and smaller tooth on the column etc.

The species referred to by Pfeiffer as "the preceeding," is his Pupa sagraiana. In this connection see remarks under S. obscura.

I found these shells in the collection labeled "Pupa marmorata Pfr., Cabo Cruz, Cuba. Cisneras, collector."

This species may be distinguished from the sub species S. m. polita, as described under observation in that form, from all others by the thin, scarcely flanging margin, numerous striations, and pale brownish, usually unbroken, longitudinal markings.

62 STROPHIA MARMORATA POLITA. Novo.

Polished Strophia.

Plate III, Fig. 3, front, fig. 4, side view of type.

DESCRIPTION.

Size, medium. Shell, rather thick and heavy. Striations, absent. Whirls, 9, the upper, including margin, being about equal in length to all of the others put together. Examined 25 specimens.

Form of shell, cylindrical, with the first three whirls equal in diameter, and from this the shell slopes to an obtuse point, forming an angle of sixty-five degrees. The shell is quite smooth being marked by some few, fine, but irregular lines of growth, which become rather more prominent on the upper whirl. The whirls are somewhat bulging with the suture rather deep.

Aperture, rather large and open, scarcely contracted within. The lower tooth is quite prominent, about .05 high nearly twice as long as high, accompanied on the left side by another tooth which is about half its height, yet which is as long as it, but which as it proceeds backward, diverges from it by curving around toward the column, thus the interior termination of the two teeth are nearly .10 apart and considerably widened. Both teeth are set back nearly twice their length, from the frontal bar and taken together are about central in position. The upper tooth is placed well up in the column, quite behind the outer termination of the lower tooth, is about as high as the larger, but rather thinner and extends around the column.

The margin is not produced forward beyond the diameter of the shell, is very slightly inclined backward and a little to one side, but not much beyond the diameter of the shell; it is thin, measuring about .05, is somewhat reflexed outward, about .04, and rolled over a little, but the edge is smooth. The frontal bar is quite well developed, and although it completely interrupts the striations, they can be seen through the translucent layer within it.

Color of shell, externally, yellowish white, marked with undulating longitudinal lines of yellowish brown which are more abundant on the spiral whirls, where many are as wide as the white interspaces between them. These lines are seldom broken by horizontal encroachments of white. Within, pale yellowish brown, becoming white on the teeth and margin.

DIMENSIONS.

Size of type 1.05 by .45. Largest specimen 1.25 by .50; smallest 1.00 by .40. Longest specimen, 1.25; shortest, 1.00. Greatest diameter, .50; smallest .40.

OBSERVATIONS.

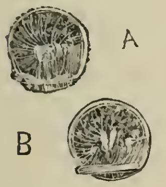
Variation consists in specimens being either lighter or darker than the type, in other words, the markings are more or less abundant, thus covering more or less of the surface of the shell. There is one distinct form as given below.

Form No. 1. Larger than the type, 1.25 by .50, otherwise similar.

This well marked sub-species differs from typical S. marmorata in the absence of striations, in the more cylindrical form of the shell, in the singularly diverging double teeth, and less converging margin. It is with considerable hesitation that I do not admit this form to full specific rank, but as I find some individuals which show evidence of intergradation, and as I found them in the same tray with the specimens of S.marmorata, described above, and consequently labeled as coming from the same locality (Carbo Cruz, Cuba.) I have thought it best for the present to consider them as sub-species only.

The difference in the teeth given above, in two such closely allied forms as S. marmorata and S. m. polita is worthy of note, as it exactly coincides with the theory, which I have had occasion to mention that the teeth of the members of this genus are vital characters, for as the animals have no muscles which grow to the shell anywhere, they depend largely upon the teeth as a means for holding themselves on the shell, therefore, with any change of environment which would tend to alter the weight of the shell would also tend to change the form of teeth. In the accompanying cut fig. 2 A. I give a figure of the teeth of S. marmorata and at ib. B, the same of S. m. polita.

Fig, 2.



A, Teeth of Strophia.
B, Teeth of S. m. polita.
Sectional view of shells.

There is a group of land shells which occur in the island of Mauritius, now included in the family Pupidae, which are closely allied to Strophia, and which possess similar teeth. In these shells the evolution of the teeth, both upper and lower, is clearly indicated. At first it is evident that the margin about the aperture was projected forward all around, when the animal for some reason lost its attachment for the shell, and required a tooth, then a portion of the margin, below the mouth, was bent inward, afterwards becoming dedatched to form a tooth; afterwards a second was formed in a similar way.

64 STROPHIA MUMIOLA Pfeiffer.

Little Mummy Strophia.

Plate IV, fig. 1, front, fig. 2, side view of typical specimen.

Pupa mumiola Pfeiffer, Wiegm. Arch., 1839, I, p. 353, and Helic. Viv. II, p. 848, 324.

DESCRIPTION.

Sp. Ch. Size small, shell, thick and heavy. Striations, present. Upper whirl with margin, about equal in length to all of the others put together.

Form of shell, an obtusely pointed cylinder, with the first three whirls equal in diameter, from the last of these the shell slopes abruptly to an obtuse point, forming an angle of about sixty degrees. The striations are about twenty to the first whirl, are rather prominent, rather regular, a little inclined to the left, are rather wide, but not quite as wide as the interspaces between them. They are slightly furrowed, smoothly rounded and polished. The whirls are not bulging, and the suture between them is quite deep.

Aperture, rather large and open, about as high as wide, and not contracted within. Lower tooth, not prominent, about .03 high, and about twice as long as high. It is about central in position, but is set far back in the mouth of the shell, at least twice and a half its length from the frontal bar; the upper tooth is about the same height and extends around the column.

The margin is not produced forward beyond the diameter of the shell, it is a little inclined backward, and a little to the right, beyond the side of the shell. It is a little thickened, measuring .03. It is rolled over, and somewhat reflexed outward, about .05, and the edge is sharpened. The frontal bar is quite well developed, and considerably inclined; the striations do not appear within it.

Color of shell, externally, rusty brown, marked with zigzag, longitudinal spots of white which are often broken into transverse lines. Internally, pale yellowish brown, becoming white on the margin.

DIMENSIONS.

Size of typical specimen, .80 by .35. Largest, .80 by .36; smallest, .75 by .32. Longest specimen, .80; shortest, .75. Largest diameter, .36; smallest, .32.

OBSERVATIONS.

There is a little variation in the thickness of the margin, some specimens measuring about .10, and in some the margin is considerably inclined to the right. The markings of this shell recall those of Strophia mumia, in fact the general form is similar, but the margin is proportionately less flanging and thicker. The resemblance is, however, sufficient to suggest the name of P. mumiola, which Pfeiffer applied to it and beyond all doubt, it is the species which he had in hand when he described his Pupa mumiola, as will be seen by his description given below.

T. breviter et profunde rimata, oblongo-ovata, solidula, corneo et albido subtiliter marmorata, remote costata; costis subrectis, validis, interstitiis costas multo superantibus; spira sub-cylindrica, apice subito in conum obtusiusculum attenuata; anfr. 9 convexiusculi, ultimus 1-3 longitudinis subaequans, antice ascendens; apertura lata, sublunaris, dentibus 2 profundis, altero intrante in ventre anfractus penultimi altero minuto superne ad columellam coarctata; perist. subincrassatum, undique expansum, marginibus callo tenui junctis. Long .20, diam. 9 mill. Ap. oblique 9 mill. longa, 8 lata. (Coll. Nr. 37.) Habitat in insula Cuba.

Translated the above reads as follows. Shell, short and deeply rimate, oblong ovate, solid, horny and white, finely marbled, striations wide apart and partly straight, the interspaces wider than the striations spire sub-cylindrical. Tip, partly cone-shaped and obtusely pointed; whirls 9, convex, the last one-third the length of the whole, front, ascending; aperture, on one side, sub-lunate, teeth two, deep. One in the interior of the belly of the front whirl, the other small and high on the column. Peristome, sub-thickened, somewhat expanded. Margins, connected by a narrow bar. Length, 20 mill. width 8 mill. Habitat, Cuba.

I found these specimens in the collection labeled "Pupa chrysalis, Cuba."

SUB-GENUS 8. SENICULUS.

LOWER TOOTH CENTRAL, NOT GREATLY ELONGATED. STRIATIONS, ALWAYS PRESENT, AND IRREGULAR IN FORM. SHELL, MARKED WITH IRREGULAR, TRANSVERSE LINES OF MIXED WHITE AND REDDISH. MOUTH, WIDELY OPEN, WITH MARGIN FLANGING. Type Strophia mumia, Brung.

This singular group of Strophias, which appears to be perfectly distinct, is characterized by the widely flanging margin, which in the type reaches the maximum development of all Strophias, rather short, low central tooth, which does not exceed three times its height in length, (see plate V for a section of S. mumia) and rough, irregular striations, combined with the mixed white and reddish colors, that appear in narrow, broken horizontal lines. The septa between the whirls in the interior of the shell, are quite smooth even on the upper whirls.

For comparison between this and other sub-genera, see remarks under sub-generic characters which are to follow. Strophia mumiola belongs to this group also the next species, S. media.

[Note ; I have purporsely avoided mentioning to what sub-genera I consider some of the shells already described in this volume should be placed, as I have not yet seen sufficient material to fully warrant so doing.]

NOTE ON STROPHIA MUMIA.

I found a large number of shells in the collection, which I have at present referred to this species, labeled as coming from Cabo Cruz, Cuba. This definitely fixes the locality for one form of the sub-genus and other similar species, (of which I have little doubt there are several) will probably be found to occur quite near. Unless otherwise convinced by the most unimpeachable evidence, it will be well for conchologists always to keep in mind that as species among Strophia, are, with very few exceptions, much restricted in distribution, sub-generic groups will also be found to be restricted. For further remarks in this connection, see observations under Strophia regia.

All of the specimens of what I have for the present considered as S. mumia in the museum collection, about 150 in all, although differing from the type form described and figured in Vol. 1, page 190-91 in having a less flanging margin, agree in general character, and exhibit no marked variation, but there is one well developed form given below.

Form No. 1. Smaller than the others, 1.30 by .50, otherwise similar. There are about ten per cent of this form.

64 STROPHIA MEDIA Novo.

Medium Strophia.

Plate IV, fig. 3, front, fig. 4, side view of type.

DESCRIPTION.

Sp. Ch. Size, medium. Shell, thick and heavy. Whirls, 10 the upper of which, including margin, is not quite as long as all of the remaining whirls together. Examined 2 specimens.

Form of shell, an obtusely pointed cylinder, with the first two whirls equal in diameter, the fourth is but little smaller, then the shell slopes to an obtuse point, forming an angle of about sixty-five degrees. The striations are few, prominent, but more so on the lower whirls than on the upper, eighteen to the first whirl, they are regular not straight, of varying widths, and all excepting on upper whirl are wider on the upper portions than on the lower, but usually a little narrower than the interspaces between them. Some are furrowed, but the majority are smoothly rounded and polished. The whirls are a little bulging, and the suture is quite deep.

Aperture, widely open, but rather contracted deep within. The lower tooth is small, about .03 high, and rather more than twice as long as high; it is about central in position, and is set back not quite twice its length from the frontal bar. The upper tooth is not as high as the lower, but extends back around the column.

The margin is produced forward about as far as the diameter of the shell, and is slightly inclined to the right, and a little beyond the side of the shell. It is reflexed outward about .10, is a little rolled over, and the edges are sharpened and roughened by breaking. The frontal bar is thin and scarcely developed in the middle, and the striations appear within it as prominences which increase in size far back within the shell.

Color of shell, externally, yellowish white, marked everywhere with longitudinal, zigzag lines of reddish brown, which are occasionally broken into lines. Internally, pale yellowish brown, becoming white on the margin.

DIMENSIONS.

Size of type, 1.20 by .50. Size of one other specimen examined 1.17 by .50.

OBSERVATIONS.

This species differs on one hand from S. mumiola by the much larger size and more flanging margin, and on the other from S. mumia by the smaller size, at least .10, than the smallest specimen of the true Mummy Strophia, in the comparatively smaller mouth, less flanging margin, predomination of the white color, with a tendency in the red markings to assume longitudinal patches, which are rather less brokeninto horizontal lines. The two specimens found in the collection were simply labeled, "Cuba."

65 STROPHIA FERRUGINEA Novo.

Rusty Strophia.

Plate IV, fig. 5, front, fig. 6, side view of type.

DESCRIPTION.

Sp. Ch. Size, small. Shell. rather thick. Strations, present.

Whirls 9, the upper of which, including margin, is about as long as the remaining whirls together. Examined 9 specimens.

Form of shell a pointed cylinder with the first three whirls about equal in diameter; below these the shell slopes to a rather obtuse point, forming an angle of sixty degrees. Striations, rather numerous, twenty-six to the first whirl, not very prominent, quite regular, straight, not furrowed, rounded and polished and a little narrower than the interspaces between them; they are slightly flattened and enlarged on the lower portions just above the suture. The whirls are bulging on the upper third.

Aperture, small, slightly contracted within the entrance. The lower tooth is quite high about .05, and is three times as long as high. It is set back about once its length from the frontal bar. The upper tooth is about one half the height of the lower, but extends back around the column; it is placed high, about half way up the side of the aperture.

The margin is not produced quite as far forward as the diameter of the shell, is a little inclined forward, and a little to the left, but scarcely beyond the side of the shell. There is but little development of the frontal bar. The striations appear within the bar, but not as prominences. The margin is thin, about .03, is a little reflexed outward and although it is not much rolled over, is not beveled, and the edge is a little sharpened.

Color of shell externally, rusty red with striations white; internally, purplish brown, becoming paler on the margin.

DIMENSIONS.

Size of type .90 by .25. Largest specimen, .90 by .40; smallest, .78 by .37. Longest specimen .90, shortest, .75. Greatest diameter, .40; smallest, .35.

OBSERVATIONS.

The chief variation in the few specimens of this singular species which I have seen is in the thickening of the margin in some specimens and in the size.

I know of no other species of Strophia which agrees with this in the peculiar bulging of the whirls on their upper parts, combined with the flattening and enlarging of the striations on the lower portion in the depression of the whirls. The color is also peculiar, and is quite unlike that of any species of Strophia which I have seen.

I found these shells in the collection bearing the label "Washed up by the tide near Jeremie, Cote de Fer." Jeremie is in Hayti, on the south western portion. The "Cote de Fer," or iron shore, is quite a common name in the West Indics, and is applied to any rough, rock-bound line of coast.

66 STROPHIA OBSCURA. Novo.

Obscure Strophia.

Plate III, fig. 5 front, fig. 6, side view of type.

DESCRIPTION.

Sp. Ch. Size medium. Shell rather thick and heavy Striations, absent. Whirls 9, the upper of which is about equal to all of the others put together. Examined 50 specimens.

Form of shell, a pointed cylinder, with the first two whirls equal in diameter, from this the shell slopes to a rather acute point, forming an angle of about 50 degrees. The shell is quite smooth, marked with faint and irregular lines of growth, which scarcely assume any prominence even on the upper whirl. The whirls are not bulging and the suture is shallow.

Aperture of medium size, quite open and slightly contracted within. The lower tooth is small, about .04 high, about twice as long as high; is single, is set back at least twice its length from the frontal bar, and is situated a little to the right of the centre. The upper tooth is about as high as the lower, but extends back around the column, is set well back, begining about in the middle of the lower, but is not set high up on the column

The margin is not produced forward beyond the diameter of the shell, is slightly inclined back at the top, and a very little to the right, scarcely beyond the diameter of the shell. It is a little thickened, about .05) is rolled over and reflexed outward a very little, (about .03) and the edge is smoothly rounded. The frontal bar is quite well developed, but is not much inclined.

Color of shell externally, bluish white, obscurely marked with zigzag, longitudinal lines of very pale yellowish brown. These markings are scarcely to be seen with the unaided eye on the upper portion of the shell, but are a little better developed on the spiral whirls, where they are rather more regular and numerous. Internally, flesh color becoming white on the margin.

DIMENSIONS.

Size of type 1.10 by .42. Largest specimen, 1.15 by .50; smallest .98 by .40. Longest specimen 1.15, shortest, .98. Greatest diameter .45, smallest, .40.

OBSERVATIONS.

Some specimens are propotionately shorter than others and there are rather more markings on some than others, many being less marked than the type. There is one well defined form as given below.

Form No. 1. More slender and more cylinderical than the type the first three whirls being about equal in size, 1.05 by .43. The suture between the whirls are quite shallow and there are few fleckings which are confined to the lower four or five whirls.

I found these shells in the collection labeled "Pupa sagraiana Pfr., Cayo Birde del Norte, Cuba."

This is not the Pupa sagraiana of Pfeiffer, however, as can be readily seen by reading his description with care. He says distinctly that sagraiana is elegantly marbled, that there are narrow striations, besides his shell was much smaller, not quite an inch long, and very slender, about .40 in diameter. It was also a differently proportioned shell as the aperture was as wide as the diameter of the shell, and very nearly as high, thus the shell was at least one fourth shorter than any specimen of S. obscura that I can find, but the aperture was fully as large.

Further on, he gives a larger form calling it Beta major, says that it is marbled with fuscous and smooth, but the size of this is given as 26 mill. by 10 mill. This is much too small for any shell of S. obscura. Pfeiffer's types of P. sagraiana came from Cayo Galinda, Cuba where he says Dr. Gundlach found it common, and it is probable that we shall have to see shells from that place before we find the true P. sagraiana.

66 STROPHIA CYCLOSTOMA Kuester.

Circular Strophia.

Plate IV, fig. 3, front, fig. 4, side view of type.

Pupa cyclostoma Kuester, Chemn., ed. II, Pupa, page 9, plate I, figs. 3 and 6, 1852.

DESCRIPTION.

Sp. Ch. Size, small. Shell, rather thin. Striations, present. Whirls, 9, the upper of which, including margin, is equal to the next six. Examined 35 specimens.

Form of shell a pointed cylinder, with the first three whirls about equal in diameter, then the shell slopes to a rather obtuse point, forming an angle of about sixty degrees. The striations are thirty -seven to the first whirl, narrow, not wider than the interspaces between them, they are somewhat angled, but the tops are smoothly rounded and polished, regular and somewhat arranged in lines and are very slightly inclined from right to left. The whirls are not bulging, and the suture is shallow.

Aperture, small, not widely open, not contracted within, circular, being about as high as wide. The lower tooth is small, and short, about .03 high and about twice as long as high. It is set back a little more than once its length from the frontal bar, and is placed a little to the right of the center. The upper tooth is placed half way up the side of the aperture, but back of the lower; it is about as high as the lower and extends back around the column.

The margin is not produced forward quite as far as the diameter of the shell; it is a little inclined backward, but is not inclined to the right, being straight, yet it projects a little beyond the side of the shell. It is a little thickened, about .03, is rolled over, but is not flanging, thus the face is smoothly rounded. The outer edge is not produced backward, but is sharpened. The frontal bar is not well developed, being nearly absent in the middle.

Color of shell, externally, yellowish white, with rather broad, longitudinal stripes of reddish brown, which are frequently broader than the white interspaces, and which are not much, if at all, encroached upon by white lines. Internally, reddish brown, becoming paler on teeth and margin.

DIMENSIONS.

Size of typical specimen, .65 by .30. Largest specimen, .72 by .32; smallest, .60 by .30. Longest specimen, .65, shortest, .60. Smallest diameter, .30, largest, .32.

OBSERVATIONS.

Individual variation consists in a greater or less number of markings. There are two well marked forms.

Form No. 1, larger than the type, nearly white in color, nearly unmarked. The margin is thicker, and the aperture rounder. Size, .75 by .35. Whirls, 9.

Form No. 2, smaller than the type, color similar, size, .60 by .30. Whirls 8.

This is beyond all doubt, the Pupa cyclostoma of Kuester as both his description and figure would seem to indicate. A translation of his description is given below.

Smaller than the foregoing species ; this is through its shape relaated with it, being connected with it through the hanging lip. While it is connected with P. uva with the continuous free lip. From P. uva it is distinguished by its color. The shell is oval-cylinderical; above, a little sharpened, as it is also in P. uva, it is a little diminished toward the tip, walls somewhat thin and polished. Column smooth.

The rest of outer surface is beset with very numerous fine striations, somewhat angled, with interspaces about the same width. The striations are somewhat curved on the upper whirls and are quite prominent, but o n the lower whirls are quite straight. The whirls, ten in number, are not bulging, (a little convex) about straight; bound together by a single deepened furrow (suture) . Mouth about round, on the wall of the mouth a strong fold (lower tooth), a second smaller one on the collumella. The margin of the mouth continuous, with a thick, produced lip reflexed outward. Ground color yellowish white, with pale reddish yellow spots, which for the most part are spread into the interspaces between striations. Mouth pale yellowish. Height 9''' length 3 2-3.''' Habitat unknown ."

I have based the foregoing description upon specimens in my own collection, but I found none in the museum collection. All are simply labeled " Cuba."

68 STROPHIA MICROSTOMA. Pfeiffer.

Little-mouthed Strophia.

Plate VI, fig. 1, front, fig. 2, side view of type.

Pupa microstoma Peiffer, Malak. Blat., 1854, page 207, plate 3, figs. 15 and 16.

DESCRIPTION.

Sp. Ch. Size, small. Shell rather thick. Striations, present. Whirls 9. The upper, including margin, being about equal in length to all of the others put together. Examined 52 specimens.

Form of shell a pointed cylinder with the first three whirls equal in diameter, from this, the shell slopes to a rather acute point, forming an angle of fifty-five degrees. The striations are twenty to the first whirl, narrow, being about one half the width of the interspaces between them, straight on all excepting the two upper whirls, where they are slightly bowed to the right; they are regular, but not arranged in lines are not furrowed, but are smoothly rounded and polished. The whirls are not bulging and the suture is rather deep.

Aperture, small, somewhat contracted within, circular, about as wide as high. The lower tooth is very small, being reduced to a mere tubercle, which is but little longer than high ; it is placed a little to the right of the center and far back in the mouth, at least four times its length from the frontal bar. The upper tooth is also a mere tubercle, is placed at least as far back as in the lower, but extends back around the column.

The margin is produced forward about as far as the diameter of the shell, is a little inclined backward, and slightly to the right, beyond the diameter of the shell; it is very thin, a little rolled over, with the edge sharpened. The frontal bar is very slightly developed, merely extending from one striation to the other, thus filling in the interspaces but not crossing the striations. The striations appear within it, even more prominently than on the outside, and they occur on the septa throughout the entire length of the interior of the shell.

Color of shell. externally, bluish white, marked with rather longitudinal patches of pale reddish brown which are irregularly distributed over the surface of the shell, and which are scarcely more abundant on the lower whirls than on the upper.

DIMENSIONS.

Size of typical specimen, .75 by .32. Largest specimen, .76 by .35. Longest specimen, .77; shortest, .63. Largest diameter, .32; smallest, .25.

OBSERVATIONS.

Individual variation consists in more or less markings, but these are never so numerous as to form the predominating color of the shell as in S. cyclostoma. One of the chief external characters of this shell is the sharply defined striations which rise abruptly from the shell. In S. cyclostoma these rise gradually from the shell at a considerable angle and are finer. The teeth are set further back in S. microstoma and are less prominent. Another noticeable internal feature in this species is the prominences of the striations, not only at the mouth, but also on the septa quite to the lower whirls.

There are four well defined forms as given below.

Form No. 1. Pure white in color, without fleckings. The mouth is rather more contracted and the striations are less prominent, otherwise similar to the type.

Form No. 2. White in color, unflecked, but larger (.75) and more cylindrical, the first four whirls being about equal in size. Whirls 10.

Form No. 3. Colored as in the type, but much more slender proportionately, and much smaller, size, .62 by 25.

Form No. 4. Very small, but otherwise a miniature of the type, size, .57 by .27.

I found these specimens in the collection labeled "Strophia microstoma ? Cuba."

This species is clearly described by Pfeiffer in the work cited at the head of this article, and his figures on plate 3 are excellent. The following is his original description.

"T. profunde rimata, subcylindrica, solidula, confertim leviter costata, albida, strigis fusco-corneis irregularites signata ; spira elongata, sensim in conum obtuscilum ; sutura impressa ; anfr. 10 vix convexiuscula, ultimus 1-3 longitudinis non aequans antice leviter ascendens basi sub-compressus, aequte striatus ; apertura lunato-rotundata, intus pallide livida, dente parietuli compresso, intrante et plica columellari obsoleta munita ; perist. simplex, breviter expansum, marginibus callo tenui junctis, columellari dilatato, paltente,—long. 21—22 ; diam. 7 mill. ap. c. perist. 7 mill. longa, 6 lata."

The above may be translated as follows ;

Shell, deeply rimate, sub-cylindrical, solid, closely and lightly ribbed, white externally, marked with irregular lines of fuscous ; spire elongated, with the cone a little obtuse. Suture impressed. Whirls 10 scarcely convex, the last, one third longer than the others, front, a little ascending, base, partly compressed. Aperture, lunately rounded, pale livid within, parietal tooth compressed within, and the fold (tooth) on the columella obsolete. Peristome (margin) simple, short, expanded. Margins joined by a slender bar. Columella dilated, open. Length, 21-22, diameter, 7 mill. Aperture, 7 mill long, 7 wide.

69 STROPHIA RUDIS Pfeiffer

Red Strophia.

Plate VI fig. 5, front, fig. 6, side view of typical specimen.

Pupa rudis Pfeiffer, Malak. Blat., 1855 ; page 102 ; Plate V, fig.1 and 2.

DESCRIPTION.

Sp. Ch. Size medium. Shell, thick and heavy. Striations, present. Whirls 10, the upper of which including margin is about as wide as the five following. Examined 6 specimens. Form of shell an obtusely pointed cylinder, with the first, second, and third whirls about equal in diameter. The fourth, is but little smaller and from this, the shell slopes to an obtuse point, forming an angle of about 65 degrees. The striations are numerous about thirty-eight to the first whirl ; they are narrow, about as wide as the interspaces between them straight or slightly bowed to the left and a greater portion of them are arranged in lines. The whirls are not at all bulging and the suture between them is shallow.

Aperture, rather small, but open, not rounded, about as high as wide. The lower tooth is quite prominent, about .06, a little more than twice as long as high, it is placed a little to the right of the center, and is set back once its length from the frontal bar. The upper tooth is very small, and is set back behind the lower, but is not placed high on the column.

The margin is produced forward about as far as the diameter of the shell, but is not much inclined to the right, only slightly beyond the side of the shell; it is thin, rolled over, with the edge sharpened. The frontal bar is only partly developed, not extending across from side to side, but the striations do not appear within.

Color of shell, externally and internally reddish, but evidently stained by contact with some red ochraceous earth.

DIMENSIONS.

Size of typical specimen, 1.12 by .42. Size of one other specimen, 1.10 by .40.

OBSERVATIONS.

There is but little variation in the few specimens which I have examined. The lower tooth is quite long, but not excessively so. This is a semifossil shell, and is beyond doubt the Pupa rudis of Pfeiffer. I append his description and a translation.

" T profunde rimata, ovata-oblongo, costis obtusis leviter arcuatis subconfertis sculpta, cretacea ; spira convexiusculo-elongata, sensim in conum obtuseulum attenuata ; anfr 11 vix convlxusculi, ultimus 1-4 longitudinis paulo superana, antice subascendens, juxta riman subcompressus ; parietati et minore, profundiore collumelari, coarctata ; perist. ciassum, breviter patulum, marginibus callo junctis, long. 30, diam. 12 mill. ap. c. perist 10 mill. longa, 9 lata.—Legitur subfossilis in plantationibus Dimond et Paradise in insulae St. Croix."

Shell deeply rimate ovate-oblong, ribs, blunt, a little arched, quite closely sculptured, chalky ; spire elongated and convex, with the cone a little obtuse at the tip ; whirls 11, scarcely convex, the last a little more than one-fourth longer, (than each of the others) front ascending, near the cleft greatly compressed ; aperture, lunately round, parietal tooth small and compressed, the one on columella deep, and compressed ; peristome, thick, short, open, margins joined by a slender bar. Length 30, diameter 12 mill, aperture of peristome 10 mill. long, 9 wide. Collected as a sub-fossil in the plantation, Dimond and Paradise in the Island of St. Croix.

SUB-GENUS 9. UMBONIS.

SHELL TURRET-SHAPED, LOWER TOOTH CENTRAL, MORE THAN THREE TIMES AS LONG AS HIGH. STRIATIONS, GREATLY ENLARGED, BULGING AND WIDENED IN THE MIDDLE, THESE AND THE INTERSPACES BETWEEN THEM ARE CROSSED BY FINE, TRANSVERSE DEPRESSIONS. APERTURE CONTRACTED, WITH A SLIGHTLY FLANGING MARGIN. UMBILICUS, CLOSED.

This is the most strongly marked group of Strophais which I have seen and is characterized by the turret-shaped shell, large, wide apart striations which are enlarged in the middle, giving each whirl a very abruptly bulging appearance.

But the most remarkable character of all, is the transverse lines or depressions which cross the shell everywhere, excepting on the first three whirls. This must be an old type of Strophia, or rather this singular feature must be one of the most primitive, for we find in many shells, even of widely different species, a tendency to revert toward this. See remarks under S. dimidiata. There are but two known species of this interesting sub-genus.

70 STROPHIA SCALARINA Pfr. et Gundl.

Embossed Strophia.

Plate VI, fig. 4 front, fig. 5, side view of type.

Pupa scalarina, Pfeiffer and Gundlach, Malak. Blat., 1861 p. 19.

DESCRIPTION.

SP. CH. Size, small. Shell, thin, striations present. Whirls 10, the upper of which, including margin, being about equal to the next four all together.

Form of shell, an oblong turret, with the first whirl the largest, from this the shell slopes to a rather acute point, forming an angle of forty-five degrees. The striations are few, twelve to the first whirl, very prominent, bulging, and enlarged in the middle, irregular, but not arranged in lines. The transverse, depressed lines appear on all but the four lower whirls, and are deeper on the upper whirl than elsewhere; they are about an equal distance apart, excepting in the middle of most of the whirls, where there is a band where they are absent; there are about twenty on the first whirl, directly below the aperture. The depression between the striations is about as wide as they, and the band, in which there are no transverse lines, also crosses these, but is narrower here. In the center of some of these depressions, are slight, longitudinal ridges or sub-striations. The suture is deep.

Aperture, very small, higher than wide, slightly contracted at the entrance. The lower tooth is about three times as long as high, is placed a little to the left of the center, and is set well back, nearly once its length from the frontal bar; the upper tooth is represented by a very slight tubercle.

The margin is not produced quite as far forward as the diameter of the shell, is placed far over to the right, and extends a little beyond the side, it is exceedingly thin, slightly flanging, but not rolled over at all and the edge is smooth. The frontal bar is comparatively well developed, very short, and the striations do not appear within it.

Color of shell externally, pale brown, but appears darker on account of the accumulation of earth in the transverse depressions; internally, also pale brown, becoming lighter on the tooth and margin.

DIMENSIONS.

Size of typical specimen, .75 by .25 Size of one other specimen examined, .70 by .25.

OBSERVATIONS.

I have seen two only of this remarkable species, which as Pfeiffer remarks, recalls the members of the marine genus, Scalaria. There need be no comparison made with other members of the genus as far as yet known, for none have the peculiar turreted form, large striations, which in this respect reach the maximum development among Strophias, while they also represent the minimum in numbers, and it is the most acutely pointed Strophia which I have seen.

The following is the original description from the work cited at the beginning of this article.

"T. profunda rimata, turrito-oblongo, solida, valide plicata, cornea, plicis albidis; spira subregularter attenuata, apice obtusa, anfr. 10 1-2 supreni planiusculi, striati, 6 ultimui convexi, subangulati, ultimus 1-3 longt fere foramens, basi compressus, striatus; apertura vix obliqua ovalis, denticulo profundo, parietuli coarctata; perist. subcontinunum, breviter adnatum, album, reflexum. Long 18, diam. 6 2-3 mill. Ap. c perist. 5 2-3 mill. longa, 4 1-2 lata. Hab. prope Gibara.

Translated may be read as follows. Shell, deeply rimate, turreted, oblong, solid, strongly plicated, ribbed outwardly, ribs white; spire, subregular, sharpened, tip obtuse, whirls, 10 1-2, somewhat even, striated, with the six last convex, sub-angular; the last one-third the others; with a little opening (umbilicus) compressed at the base and striated. Aperture a little obliquely oval, tooth deep, with sides compressed.

Peristome sub-continuous, short, connected, (by the frontal bar) white, reflexed. Length, 18, diameter 6 2-3 mill. Aperture of the peristome 5 2-3 mill. long, 4 1-2 wide. Habitat Gibara.

They also say that the specimens which they had were dead and bleached, and probably being worn they did not observe the singular transverse lines, whereas the two which I have in my collection, from which I have made the above description, were evidently living when found.

Gibara is on the northern shore of Eastern Cuba, about thirty-five miles west of Point Lucrecia Light-house. Although I have seen but a single species of this sub-genus, I have no doubt but what others will be found in the immediate vicinity.

SUB-GENUS 10. PINGUITIA.

FORM OF SHELL, SHORT AND THICK, THE WIDTH BEING AT LEAST ONE HALF THE LENGTH. THE FIRST TWO OR THREE WHIRLS ARE ABOUT EQUAL IN DIAMETER, WITH THE OTHERS ABRUPTLY SMALLER. TEETH, NOT PROMINENT. MARGIN, NOT BEVELED.

The most remarkable feature of this sub-genus is the short, thick form of the shell with its abrupt termination at apex, forming the widest angle of any known Strophia, over eighty degrees. There is but one known species.

71 STROPHIA DIMIDIATIA Pfeiffer.

Protean Strophia.

Plate VI, fig. 6 front, fig. 7, side view of type.

Pupa dimidiata Pfeiffer, Zeitshr. f. Mal., 1847, page 19.

DESCRIPTION.

SP. CH. Size, large. Shell thick and heavy. Striations, present on upper whirls. Whirls, 10, the upper of which, including margin is about as long as all of the rest put together.

Form of shell a very obtusely pointed cylinder, with the second whirl the largest, the first and third being a little smaller; from the latter named, the shell slopes abruptly to a very obtuse point, forming an angle of eighty two degrees. Striations not numerous, twenty-eight to the first whirl, they are confined to the first two whirls being reproduced on the others by roughened lines of growth; they are not prominent, narrow, about one half the width of the interspaces, irregular, furrowed, somewhat lengthened, and bent to the right at their lower terminations. The whirls are slightly bulging, and there is an elevated keel pass ing around the center of the upper half of the upper whirl from one side of the margin to the other. The elevated lines in the middle of the upper part of the upper whirl is very prominent, and is preceded above by a depression. When it is crossed by the striations it is raised into protuberances and ends in a prominent projection on the right margin. There are also numerous, transverse depressed lines on the upper whirls. The suture is quite shallow, even between the upper whirls, and this grows more and more shallow toward the apex until on the lower whirls it is scarcely to be distinguished with the unaided eye.

Aperture, rather small, but open, not contracted within. The lower tooth is not prominent, being tubercle, arising gradually from the floor of the mouth, without any sharply defined sides; it is placed to the right of the center and set back about .20 from the frontal bar. The upper tooth is scarcely developed at all.

The margin is produced forward about as far as the diameter of the shell, it is inclined a little backward on the upper left hand side, but elsewhere a little forward; it is about .05 thick, is rolled backward, somewhat, but not beveled, the edge is blunt; it is not inclined to the right. The frontal bar is quite well developed, slightly inclined and completely interrupts the striations, and the septa is smooth throughout.

Color of shell externally, yellowish white, pale flesh color within, fading into white on the tooth and margin.

DIMENSIONS.

Size of typical specimen, 1.02 by .64. Size of two other specimens 1.07 by .64, and 1.03 by .67.

OBSERVATIONS.

There is probably considerable individual variation, as well as some clearly defined forms in this singular species, it is also probable that there are sub-species and allied species, but the material which I have at hand will not warrant any, even sub-specific, separation. I give below one form, which was also observed by Pfeiffer.

Form No. 1. Similar to the type form, but without any distinct keel on the upper whirl, this being merely indicated, and the depressed lines are wholly absent, while the striations are confined to the two upper whirls.

These depressed lines, as already mentioned, show a tendency to revert toward S. scalarina, and in this connection it is worthy of note that both species came from the same portion of Cuba.

This species was first described by Pfeiffer in 1847 in Zeitschr. f. Mal., as Pupa dimidiata, but in 1861 in Malak. Blat. in a paper published jointly by himself and Dr. Gundlach, we find the same species redescribed and renamed Pupa proteus, because, as Dr. Pfeiffer states, he considers that he did not fully appreciate the extreme variation to which the species was subject, therefore he did not at first describe a typical form, which in his second paper, he considers the keeled form. But of course, following modern usage, his second name becomes a synonym.

Dr. Gundlach states that the shell occurs on bushes and under leaves near Gibara, Cuba, and that the living animal is white or gray with the head and neck blackish with a blackish roughness, in contrast with which the white colors of the feelers [eye stalks ?] show more plainly. The feelers have the tips gray.

The following is a transcription of Dr. Pfeiffer's description with a translation.

"T. rimata, cylindraceo-ovata, solida, distanter et arcuatim plicata, sordide alba ; spira alveariformis, apice breviter conica ; sutura levis ; anfr. 11 angusti, planiusculi, supremi laevigati, ultimus dimidiatus, medio subcarinatus, infra angulum lineis nonnullis impressis, confertis, spiralibus notatus et excentrice confertim striatus, basi gibbus ; apertura subsemicircularis : perist. incrassatum, expansum, marginibus callo stricto junctis, dextro subauriculato.—Long. 30, diam. 16 mill.—Ap. c perist. 13 mill. (oblique) longa, 11 lata. (Coll. Nr. 26.) Habitat in insula Cuba (Gruner).

Obs. Variat carina et lineis impressis basalibus obsoletis."

Shell rimate cylindrical-oval, striations wide apart and arched, soiled white ; spire beehive-shaped, tips. short conical, suture smooth ; whirls 11 narrow, even, the first smooth ; the last divided in halves by a medium sub-keel, below the angle everywhere crowded, depressed lines. Spire with prominent and eccentric, crowded, striations, base swollen ; aperture semicircular, peristome thickened, expanded, margin, joined by a narrow, straight, bar, sub-auricular on the right. Length .30, diameter, 16 mill. Aperture of the peristome 13 mill .long 11 wide, (Coll. No. 26) Habitat in the island of Cuba (Gruner).

Observations. There is a variety in which the impressed lines at the base are obsolete.

72 STROPHIA FAXONI.

Faxon's Strophia.

Plate VII, fig. 1 front, fig. 2, side view of type.

DESCRIPTION.

Sp. Ch. Size large for this sub-genus (Umbonis). Striations, present, shell rather thin. Whirls, 11, the upper of which, including margin, is as long as the next four.

Form of shell an oblong turret, with the first two whirls about equal in diameter, from the second, the shell slopes to an acute point, forming an angle of about forty degrees. The striations are few, thirteen to the first whirl, very prominent, bulging, not greatly enlarged in the middle, regular and crooked, and not arranged in lines. They are not an equal distance apart, but the interspaces between them are always twice as wide as the prominences ; and there are longitudinal sub-striations indicated in some of the depressions. Both striations and interspaces are crossed by narrow, transverse lines, which are, however, everywhere about an equal distance apart, without any unmarked interruptions in the center of the whirls. These lines are about .01 apart, and there are about twenty of them on the first whirl beneath the frontal bar. The suture is deep.

Aperture, not very small, about as high as wide and open. The lower tooth is not prominent, rising gradually from the floor of the mouth, is about twice as long as high ; it is about central in position, and is set back about once its length from the frontal bar. The upper tooth begins a little back of the lower, is about its size, and is placed low on the column.

The margin is not produced quite as far forward as the diameter of the shell, is inclined backward on the upper left side, and the lower right further than on the corresponding portions on the opposite side, in this respect resembling S. scalarina, hence this peculiarity becomes sub-generic. It is considerably flanging, especially on the right side, about .07, and here it is somewhat roughened by minute tubercles which are arranged in radiating or transverse lines. The frontal bar is very prominent, extending well out beyond the shell. The transverse striations appear on the right side of the tooth, and continue far within the shell.

Color of shell, pale yellowish, externally, but the specimens have evidently been cleaned and thus the transverse lines do not contain any soil. Within, very pale yellowish, becoming white on the margin.

DIMENSIONS.

Size of type, 1.12 by .40; size of one other specimen examined, 1.20 by .40.

OBSERVATIONS.

Rather singularly after my article upon S. scalarina was in type, I found two specimens of S. faxoni in the museum collection of which I have just described, thus confirming my theory that there must be more species found of this remarkable sub-genus, for, although these specimens were simply labeled "Cuba," I have no doubt but what they came from the neighborhood of Gibara, Cuba.

S. faxoni differs from S. scalarina not only in being at least three times as large, but also in other important particulars. The form of the shell is rather different, the first two whirls being about equal in diameter, the margin is more flanging, and on the right side has the peculiar minute tubercles, arranged in lines. The striations are also quite different, being irregular, narrower and crooked, and not enlarged in the middle. I have named this species for Dr. Walter Faxon, who has displayed the utmost interest in my work upon Strophia and also has kindly aided me in many ways.

73 STROPHIA CYLINDRICA. Novo.

Cylindrical Strophia.

Plate VII, fig. 3, side, fig. 4, front view of type.

DESCRIPTION.

Sp. Ch. Size medium, shell thick and heavy. Striations, present. Whirls, 10, the upper of which, including margin, about equal in width to the next four all together.

Form of shell, an obtusely pointed cylinder, with the first three whirls equal in diameter, the fourth is but little smaller and from this the shell slopes abruptly to an obtuse point, forming an angle of sixty degrees. The striations are numerous, twenty-four to the first whirl, they are not very prominent, straight, but slightly bent to the left on the suture, and they extend along it, tapering into a point; they are polished above, not furrowed, arranged in lines, and are of varying width, but are never wider than the interspaces between them. The suture is very shallow and very narrow.

Aperture, quite small, not open, nor contracted within. The lower tooth is not more than .03 high, and is about four times as long as high, is set back about .12 from the frontal bar. Behind this central tooth on either side the chancelled tooth begins and extends around the first whirl. The upper tooth is about as high as the lower and extends back around the column.

The margin extends forward as far as the diameter of the shell, is a little inclined backward and very slightly to the right, but scarcely beyond the diameter of the shell. It is not thickened, is rolled over, but not flanging and the edge is rounded. The frontal bar is quite well developed, yet the striations appear within it, but they are not very prominent and extend back far into the shell.

Color of shell, externally, shining white; within, deep purplish brown, pale on the tooth and internal striations. Margin, pale brown.

DIMENSIONS.

Size of type, 1.10 by .40. Largest specimen, 1.28 by .45; smallest .85 by .38. Longest specimen, 1.28; shortest, .85. Largest diameter .45, smallest, .35.

OBSERVATIONS.

Typical specimens are wholly white externally, but there is a strong inclination to become rosy at the apex, this feature is more prominent in the form given below. There are also other forms.

Form No. 1. Shorter, and proportionately stouter than the type. The apex is distinctly rosy and there are occasional lines of dark violaceous. This form exhibits a tendency on one hand to revert toward S. ianthina, and on the other toward S. rubicunda.

Form No. 2. Very short, .85, with the margin thickened and beveled. Color similar to that of form No. 1.

Form No. 3. Larger than the type, 1.28 by .45, with the margin much thickened, at least .75, and inclined to be double. Color, similar to that of the type.

Form No. 4. More slender than the type, measuring .35 in diameter, white in color.

I cannot give the relative proportions of these forms nor their exact locations, as I did not make sufficiently, careful notes on them when I collected them.

This is the species which in many collections is labeled Pupa alvearia, but erroneously, as I shall endeavor to show. The Turbo alvearia of Dillwin (Description Catalogue, II, page 315) was based partly upon the Alvearia buccinum of Seba and partly upon the Bulimus fusus of Burguiere (Encyclopedie Methodique, des vers, Vol. 1 page 348) hence must be considered as a synonym of Bulimus fusus. What the Alvearia, buccinum of Seba was, is very doubtful, but it is quite probable that neither he nor Burguiere had a true Strophia in hand, when they made their description. and even if they had, their description does not apply to any Inagua shell with which I am aquainted. Dillwin distinctly says his Turbo alvearia, was " white without and within " and this appears to be a correct interpretation of the authors upon whose description he bases his specific characters. Now this does not apply to any Strophia from Inagua which I have seen, for all, without exception are colored within, none being white, even if they are wholly white externally.

The name alvearia, having become a synonym is not again available in zoological nomenclature and, as shown, Bulimus fusus of Bruguiere afterwards the Pupa fusus of more recent authors, probably is not a Strophia, but one of the peculiar members of the great family of Pupidae which occur in the Isle of France, to which locality it appears to be correctly assigned by Pfeiffer in his Monographia Helicorum Viventium, Vol. II, page 318, hence it remains for me to impose a new name upon the Inagua species.

DESCRIPTION AND HABITS.

I found the Cylindrical Strophia common in December, 1888, on the Island of Inagua, Bahamas. They were clinging to the trunks of small trees, just back of Matthewstown, and appeared to have a somewhat wide range, extending throughout the scrub lands from the town to the borders of the salina in the interior. December being a dry month, they were inactive, and firmly fastened to the trunks. They appeared to avail themselves of any natural cavity and had often wedged themselves into these so firmly as to be removed with difficulty. They were always gathered in groups of from three or four to twenty individuals.

SUB-GENUS 2. STROPHIOPS.

LOWER TOOTH, LOW, RISING GRADUALLY FROM THE WALLS OF THE MOUTH, SOMEWHAT ELONGATED, AT LEAST THREE TIMES AS LONG AS HIGH. UMBILICUS OPEN, WITH THE SAME DIAMETER, FOR SEVEN OR EIGHT UPPER WHIRLS.

This sub-genus was established by Dr. Dall in 1895, in the Bulletin of the Museum of Comparative Zoology, No. 9, Vol. XXV, pages 121-123, but in this group he also included all of the species found on the Cayman Islands which I have placed in the sub-genus Longidens (see page 39). This group appears to be confined to some of the outer Bahama Islands which lie along the Atlantic side of the Bahama Bank.

Thus Strophia alba S. lentiginosa and S. brownei from Rum Key belong here, also all of the species which I have described from Highborn Key but not from the keys about Allen's Harbor. For further remarks regarding the relationship between this sub genus and the Strophias which occur on the Cayman Islands, see Sub-Genus 11.

74 STROPHIA REGIA Benson.

Regal Strophia.

Plate VII, fig. 5, front, fig. 6, side view of typical specimen.

Strophia regia Benson. Ann. and Mag. Nat. Hist., 2d series, Vol. IV, page 125, August, 1849.

DESCRIPTION.

Sp. Ch. Size very large. Striations absent. Shell thick and heavy. Whirls, 11, the upper of which, including margin, is as long as the next five put together.

Form of shell a pointed cylinder, with the first whirl the largest, then each successive whirl is a little smaller to the fourth, and from this the shell slopes to a rather obtuse point, forming an angle of about sixty-five degrees. The surface of the shell is smooth, marked with irregular lines of growth, which are more prominent on the upper whirl near the margin. The whirls are not bulging, and the suture on the upper whirls is quite deep, but is much more shallow between the lower.

Aperture large and open, about as high as wide, not contracted at the entrance. The lower tooth is low, about .05, and is about three times as long as high, is about central in position, and is set back a little over once its length from the frontal bar. It rises gradually from the floor of the mouth, thus it is pyramid-shaped. The upper tooth is about the same form as the lower, and is about as high, but extends back around the column, ending on the beginning of the second whirl. It is placed half way up the column.

The margin is not produced forward quite as far as the diameter of the shell, is considerably inclined to the right, beyond the diameter of the shell, it is inclined backward on the upper right, and lower left corner; it is rolled smoothly over, and is considerably flanging, about .10, the edge is rolled over and roughened by breaking.

Color of shell, externally, shining white; internally, golden brown, passing with almost an abrupt line of demarkation back of the teeth into yellowish on the teeth and margin. Frontal bar slightly developed on either side, obsolete in the middle.

DIMENSIONS.

Size of typical specimen, 1.85 by .70; size of two other specimens 1.67 by .65, and 1.70 by .65.

OBSERVATIONS.

There is but little individual variation shown in the four specimens which I have seen of this fine species, which can readily be distinguished by the largest size (the largest Strophia known) smooth surface and widely open umbilicus, the column being about the same diameter for nearly its entire length.

This is not the Conchlodonta decumana of Ferussac (Prodromus page 462) nor is it the Pupa decumana of Pfeifier (Mon. Helic. Vol. II, page 320) for his description is based upon Ferussac's, and both describe a species which differs from the true S. regia in at least two important characters, namely, in being irregularly and strongly ribbed, and in having the umbilicus imperforate. Pfeiffer, who says he had a specimen from the collection of Metcalf, gives St. Thomas as the habitat.

Although the present species should undoubtedly bear the name of S. regia, it is with some hesitation that I give Benson as the authority. In the Annals and Magazine of Natural History, 2d series, Vol. IV, August, 1849, page 125, Benson describes a shell which he calls Pupa regia, and which he says positively came from Nankin, China. Now although his description in general fits the species which I have given as Strophia regia very well, his dimensions are of a shell having widely different proportions, forexample, his shell was 44 millimeters long by 23 wide, hence his shell was a little more than half as wide as long, thus giving a width which in proportion to the length, is exceedingly rare in Strophia, and quite different from that of any S. regia which I have ever seen. There can be little, if any doubt, but what Mr. Benson was mistaken in saying the shell he described came from China, but how he came to give such a widely different width than is to be found in specimens of S. regia which came from Castle Island, Bahamas, is more difficult to say, and were it not for the fact that three years later, in 1852, Kuester, who was evidently familiar with Benson's type, gave a new description, (his dimensions being 19''' long by 7 1-2''') and an excellent figure of what we now know to be a typical Castle Island S. regia (Chem. ed II. Pupa, plate 17, figs. 13 and 14) I should be inclined to doubt that Benson had this species at all, but some other species which came from some different key. It is noteworthy that Kuester also gives the habitat of the species as Nankin, China, and it was not until about 1881, that conchologists became aware that this fine shell came from Castle Island, Bahamas.

I add Benson's original description from the work cited at the head of this article, with a translation. Benson in some prefatory remarks, seems quite elated over the fact that he has discovered such a fine species of Pupa so far from the usual habitat of other members of the genus.

"T. profundissime umbilicata, elongato-conica, subcylindrica, solda, alba, laevigata, nitidiuscula, oblique et remote, obsoleteque plicato-striata; spira superne sensim attenuata, apice obtusiusculo; umbilico pevio; anfractibus undecim subplanulatis, ultimo antice ascendente, validus plicato, ab basin compresso; sutura lineari, irregulariter crenata; apertura obliqe truncato-ovata, sublaterali, ab axe deviante, intus fulvida: plica columellari profunda. duplicata, paretali elongata, remotiuscula; peristomate valde incrassato, reflexo, subtus latiori, extus angulum efformante, dextro medio antrosum arcuato.

Long. 43 mill. lat. 23; aperturae long. perist. incl. 18 mill. Lat. 9 millim. Habitat prope Nanking, China.

Brought by the late Dr. D. King, H. M. S. Cornwallis, and presented by him to Dr. Cantor, to whose kindness I am indebted for the specimen. A wire introduced into the umbilicus, will reach within a short distance of the summit."

Shell deeply umbilicated, elongated, cone-shaped; sub-cylindrical, solid, white, smooth, shining, striated folds indistinct, wide apart and oblique: spire, a little sharpened, with the tips somewhat obtuse, umbilicus open; whirls, 11, even, the upper ascending and strongly plicated, somewhat compressed: suture, linea and irregularly crenulated: aperture, oblique, slightly ovate, deviated a little to one side, brownish yellow within, tooth on the columellar deep, considerably elongated. Peristome, strongly thickened. reflexed a little, expanded laterally, without any angle, arched to the right of the center of the entrance.

43 mill. long by 23 wide; aperture, including peristome, 18 mill. long by 18 wide."

GENUS 11. LONGIDENS.

Strophiops Dall (in part) see page 33 for citation.

Lower tooth greatly elongated, four times as long as high, and about one fifth as long as the shell. Umbilicus, nearly or quite closed. Aperture, not widely open. Margin not flanging, thickened and beveled. Type S. pannosa.

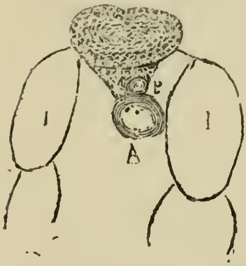
The central tooth arises abruptly from the floor of the mouth, being narrow, not wider than high, even at the base. The difference between members of this sub-genus and those of Strophiops lies in the long tooth, which is about one fifth as long as the shell, whereas in the typeof Strophiops, S. regia, it is only about one eighth as long as the shell, in other words, the tooth in S. pannosa is absolutely as long as in S. regia, although the shell is only about half as large. The mouth in Longidens is not widely open, nor is the margin flanging, but thickened and beveled, and, above all, the umbilicus is nearly or quite closed, not widely open as in Strophiops. In Strophia, as I have already remarked, it will be found that the natural groups, which we call sub-genera, are comparatively limited in disturbution hence the type of a given sub-genus should be selected from the area inhabitated by the greatest number of species. I have never yet seen a member of the sub-genus Longidens, taken off the Cayman Islands, which I regard as its proper habitation.

I have to thank Dr. Dall for kindly sending me his type of Strophiops, S. regia, for examination.

NOTES ON AN AGED LEGHORN HEN.

In the autumn of 1895, my friend. Mr. F. C. Browne of Framingham gave me a white Leghorn hen which, as near as he can remember, was about ten years old, and which had assumed secondary sexual characters, that is, she had the elongated tail feathers and hackles of the male. These began to appear in 1894, at which time she began to crow. That year she laid two eggs only. In 1895, she laid one only. When she came into my possession in October, 1895, she had evidently ceased crowing, for I did not hear her do so while in my possession.

Fig. 3

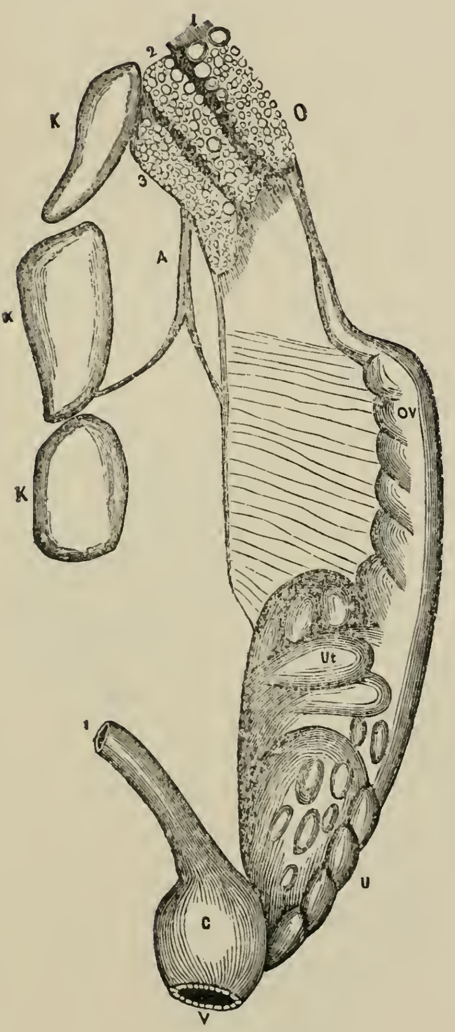


Exhausted ovaries o Domestic Fowl.

When placed with some young Buff Cochins of my own, which were about two thirds grown, the old hen behaved much as a rooster would under similar circumstances, strutting about among the young pullets and uttering the peculiar sounds emitted by the males at such times, and she would also drive the young roosters about until they became quite frightened whenever she appeared.

She did not remain long with these fowls, however, but escaping one day, concealed herself among some weeds and bushes so effectually

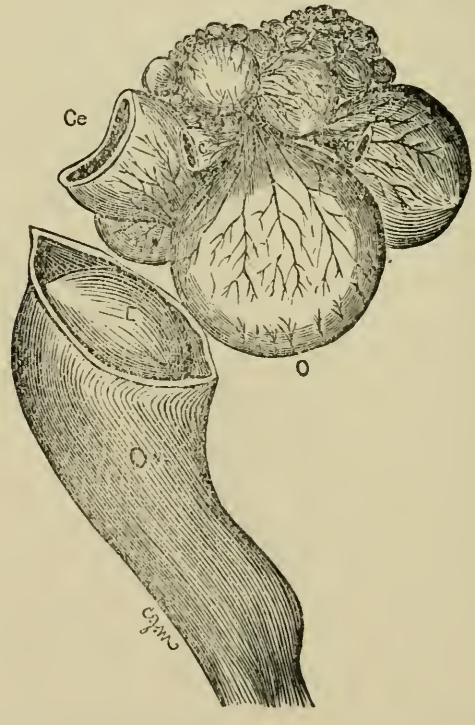
Fig. 4



Ovary and oviduct of a young Domestic Fowl. o. ovary 1, 2, 3 folds of ovary ; ov, oviduct ; ut, uterus ; u, lower portion of uterus · i, intestine ; c, clocoa ; v, vent ; k, k, k, kidneys ; A, renal vessel.

that I could not find her. At last, I managed, with the help of my dog, to locate her and found, to my surprise, that she would lie before the dog much as a quail would have done, then upon being approached by me would suddenly rise and endeavor to fly away. Although I readily caught her at such times, after a short chase, and placed her in confinement, she managed to escape several times, always preferring to live alone in the bushes, rather than to associate with the other fowls. She continued to live in this way for nearly six weeks. Meanwhile my Buff Cochin roosters had greatly increased in size. About the first of November when I placed the old hen among them, I was amused to observe that the tables were completely turned, for then the roosters attacked her as soon as they saw her and drove her into a corner, and

Fig. 5



Ovary of a laying Domestic Fowl, enlarged, c, next ovule to be deposited; ce, ruptured capsule of last egg laid; c, c, capsule of eggs laid previously, ov, oviduct; E, its entrance.

had I not promptly rescued her, would quite likely have killed her. Ever after this, whenever they saw the old hen, four or five of them would rush off in a body after her, evidently recognizing her as being an utterly worthless member of the fowl community.

During the last week or so of her life, which she passed in comfort alone, the old Leghorn became more tame, but would never permit me to handle her without a struggle. She died on November 22, and a post-mortem examination revealed the fact that the cause of her death was a diseased liver, this being greatly enlarged and in a nearly putrescent condition, the cavities being filled with pus.

But what I was most anxious to examine were the ovaries. These I found to be completely exhausted; not a single ovule being left. The ruptured capsules were abundant and presented much the appearance seen in the cut, fig.3. At A, I found one of the capsules greatly distended with a watery fluid and at B, was a smaller one. The examination of this fowl exactly confirms my theory that the life of a bird practically ends with the exhaustion of the ovary.

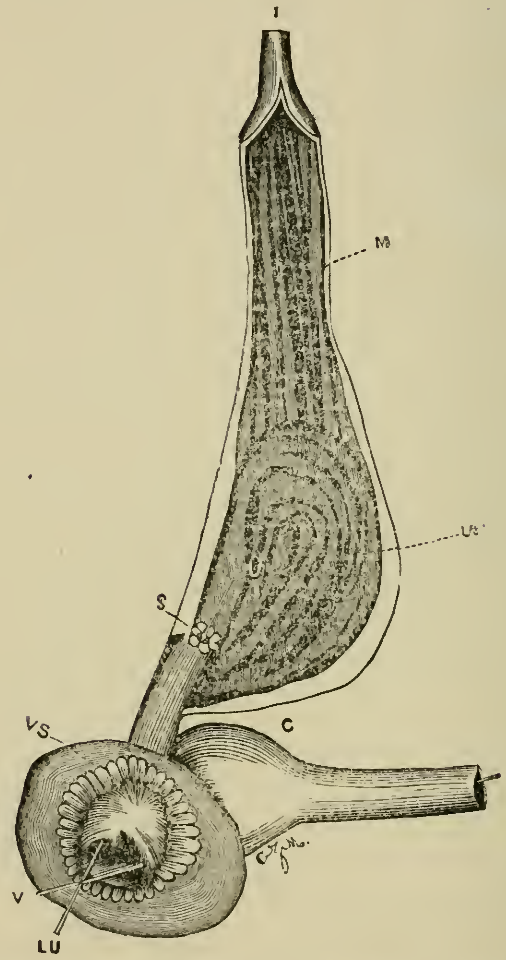
For comparision with the ovary of a young Domestic Fowl see fig. 4, where I have given a life sized cut of these organs. It is noteworthy that the ovaries in young hens lie in folds which are in a measure separate ovaries (see ib. o, 1, 2, 3.) exactly as if with an increase of prolific power one ovary after another had become evolved. The other accessory organs are explained under the cut.

In fig. 5, I give an enlarged view of the ovary of a laying hen to show the relative position and size of the ovules and ruptured capsules.

The next ovule to ripen and fall into the oviduct ov, the entrance of which is at e, would be the large one at o ; others would follow in regular succession, according to size. The ruptured capsule of the the egg which was deposited, probably the day before the hen was killed, is seen at ce, those of previous days are marked c. c the one to the right being three or four days old. This illustrates how quickly the capsules shrink, yet they are always visible, as seen in fig. 3, page 40. In this connection, see the ovary of a Blue Bird, page 105, Vol. II of Contributions.

On page 44, fig. 6, I give a cut, life size, of the oviduct of a Domestic fowl, with the explanation of the parts.

Fig. 6.



Oviduct, life size, of Domestic Fowl, open to show interior: I, upper portion; M, mucous membrane; U, uterus; S, vagina; L U, bristle passed through vagina; V, bristle passing in cloaca; V S, muscles surrounding vent; C, cloaca; I, intestine.

A THEORY TO ACCOUNT FOR THE MIGRATION OF BIRDS AND OTHER ANIMALS, AND NOTES ON THE ORIGIN OF GROUPS.

The present article is intended as preliminary to a much more extended work which I have in hand, especially upon the origin of groups among birds and other animals. As remarked below, the subject of migration and the origin of natural groups among animals, are closely connected, one throwing much light upon the other. In an address given before the Boston Scientific Society last November, an abstract of which was printed in the Boston Commonwealth for Nov. 30, 1895, I gave many of the ideas here written, but they are now much more elaborated.

As far back as history or tradition extends, from the time when quails came up from the sea to satisfy the unlawful longings of the children of Israel for the fleshspots of Egypt, even until the present day have the migrations of birds been considered a mystery.

Now I do not know whether the theory which I am going to advance is absolutely new or not, for I have purposely avoided reading up on the subject in order that what I have to say may have the advantage of being from independent observations. But of this I am certain, that up to date no theory has been presented in a sufficiently forcible manner to satisfy ornithologists in general that it is correct. Mr. Alfred Newton, the celebrated English ornithologist, in his article upon birds, published in the last edition of the Encyclopaedia Britannica, says that the migration of birds is the 'mystery of mysteries.' In the recent work upon the migration of birds in Heligoland, the author not only does not advance any theory but goes as far as to say that migration never has been satisfactorily explained nor can it ever be explained. An able American ornithologist, in reviewing this work, practically says that this statment is one of the best parts of the book.

We have all of us, without doubt, seen an old hen who, after rearing a brood of chickens with great care, giving them every attention through the earlier portions of their career, when they have arrived at a certain age suddenly turn upon them and by blows from her beak drive them from her. That old hen has by that act furnished the clew to the solving of the mystery. In other words, when the hen struck the first blow at her offspring, she sounded the keynote which vibrates through the whole system of migration of birds and other animals.

I do not mean to say, however, that I was bright enough to pick up the clew given me so repeatedly by old hens. No, although I have seen hens as well as other birds driving their offspring from them many times. it did not occur to me that this was the end of the thread that leads through the labyrinth of migration. I came at the matter in another way, and only followed out the thread which led to the hen and her chickens from the inside, after the matter had become plain to me.

I had been working upon a problem concerning two hypothetical species of birds, and the study which this involved led me to look into the origin of certain groups of birds. It then occured to me that migration of birds would greatly aid us in determining the origin of groups of birds: when like a flash came the thought, why, the origin of groups of birds surely furnishes a certain clew to the origin of that instinct of which we call the instinct of migration. I, for one, had been always thinking about migration from the wrong end. Then it was that I saw that the hen and other birds had been offering me the clew so long, but I, neglecting an easy way in, had fairly stumbled over the wall.

First I must go back to the beginning; yes, even to the beginning of migration, to a time when we can be reasonably certain that there was no annual migration, or at least no migration north and south, north of the equator. This was during the last Glacial Period.

Whether prior to this time, when the northern hemisphere was overwhelmed by the great ice sheet, the fauna inhabiting the arctic and temperate zones were migratory, is exceedingly difficult to say. Of one thing we can be certain, and that is that all animal life either had to retreat before the ice sheet or be overwhelmed by it. Probably most birds retreated before it.

At a time, then when the ice had reached its nearest point to the equator, the birds and other animals would be forced into comparatively narrow limits. Possibly, and even probably, the fauna consisting of all classes of animals was quite limited at this time; but then as now the parent birds were driving their young away from them and were causing them to spread over every possible space of land, east and west. But to the north they were hemmed in by the ice and so could not go far in that direction. After a time, how long a time we do not know, the great cold cycle began to abate and the ice sheet began to melt, backing toward the north pole, slowly at first, leaving a desolate land exposed. But nature always hastens to clothe desolate spots with verdure; and following vegetation came insects spreading gradually to the northward. The birds, induced to scatter by their parents, would hasten to occupy any section which offered food for them, and both insects and plants would do this. The birds which occupy the new section would in time remain and breed there, even if they did not do so at first. Now let us remember that even during that season of cold there were still seasons, and that with each recurring winter the ice advanced somewhat toward the equator. The ice and cold near it would drive the birds backward again, and naturally they would return to their birth-place and their young would as naturally follow them. With the retreating cold in the following spring, the birds which had formerly bred further north would naturally return to their former breeding ground and the young to their birth-place, and all with their progeny would again have to retreat before the cold in the autumn. Thus an incipient migration began, which in time became hereditary, or, to use a synonymous term, instinctive.

Of course, these migrations were very short at first, only a few miles in length, for the change in the climatic conditions must have been slow; yet they were the beginning of migration will all its seeming mystery.

One of the difficulties with which this theory has to contend is that some birds now pass over large bodies of water; but we can have little doubt that they at first went around them and little by little, as the migratory instinct became more strongly fixed, they learned to cross the water. Many of our species now, in going as far south as northern South America, reach that place by going around the Gulf of Mexico and the Carribean Sea by the way of Mexico and Central America.

That birds have a strong love for localities no one who has studied them at all can doubt, and they will return to breed in given localities even though they are constantly persecuted there. Twenty-five years ago, I found the gannets and razor-billed auks breeding on Bird Rock in the Gulf of St. Lawrence. There they were slaughtered by by hundreds by the fishermen. This persecution had been carried on for years and has doubtless continued ever since; yet according to reports of recent visitors the number of the birds has not greatly diminished.

The instinct for migration once established, this love for locality in which they have bred will induce these birds to return to it year after year, while the young return as near as their parents will permit them to their birth-place.

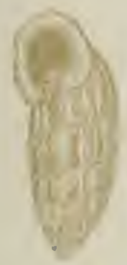
Now why is it that birds migrate northward with such regularity as regards time? The answer is easy to one who has seen them leave their winter quarters. Birds breed very regularly, all of any particular species beginning to lay within a few days of each other. It is the beginning of the enlargement of the reproductive organs which shrink much after the breeding season is over that induces birds to begin to migrate northward; and at this time the males generally begin to sing so that when we hear their songs we know that they will soon migrate.

The beginning of a southward migration is induced by two causes. First and most important is the lack of food. In insect eating species this lack will occur through increasing cold in the autumn. But this will not explain why such strictly insectivorous birds as the chimney swift, some of the swallows and some of the warblers migrate even in August or early September, when insects are still abundant. Strange as it may first appear, I answer that the increasing length of the night causes these birds to migrate thus early.

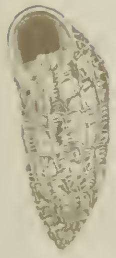
In order to explain this we have to understand a little about the physical condition of birds. In most of these animals the blood circulates very rapidly and digestion and all other functions are carried on much more rapidly than in mammals. They have to feed more often than mammals in order to acquire the supply of nutriment which they need. Insect food is assimilated more rapidly than is a vegetable diet, consequently swallows and swifts are almost constantly upon the wing in search of food. When the days are long and the nights short, they have a longer time to feed: but when the reverse in the case, and the nights become more than ten hours long, then the truly insectivorous birds cannot obtain food enough to last them through the long night. This is especially true when we consider that in order to withstand the fatigue of migration birds must be in good condition before they start, and long nights would draw upon the accumulated supply of fat which has to be used upon the southward flight.

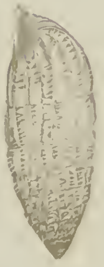
A difficulty in this theory of migration which must be answered is the fact that some species are not wholly migratory; examples are the jays and crows, the titmouse, grouse, etc. The answer to this will be that as fast as species become fitted through gradual adaptation to environment to live in any locality, they lose the migratory instinct, as they have no inducement to leave a given locality. Such birds will as a rule be found to have become modified to great extent to meet the conditions under which they live. Some, as the grouse, have aquired crops, an enlargement of the gullet, in which to store food for long nights and through storms. The intestinal coeca have become greatly enlarged, so that a greater amount of nutriment is obtained from a smaller amount of food that can be assimilated by birds with smaller coeca.

PLATE I



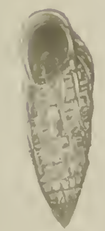
[illegible]

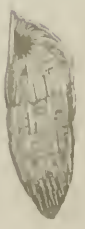




[illegible]

4





[illegible]

6

PLATE II

3

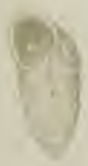
4

Strophia curvidens Maynard

1

2

Strophia fastigata Maynard



5

6

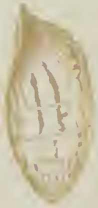
Strophia striatella Ferussac

1

[illegible]

2

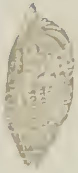
[illegible]



[illegible]

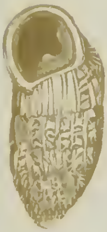
PLATE IV

1

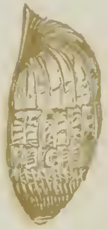


2

[illegible] Pfeiffer

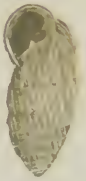


3

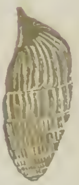


4

[illegible] Maynard,



5



6

[illegible] ferruginea Maynard,

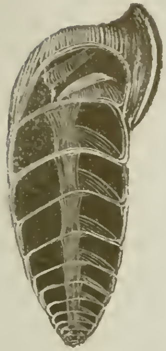
3

4

[illegible] Kuester.

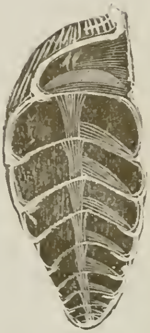
PLATE V.

SECTIONS OF STROPHIAS TO SHOW SUB-GENERIC CHARACTERS.



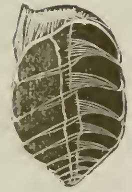
Strophiops Dall

S. regia.



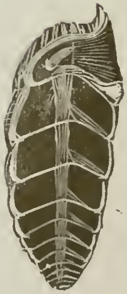
Longidens Maynard.

S. pannosa, (enlarged)



Pinguitia Maynard.

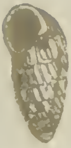
S. dimidiata.



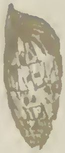
Sepculus Maynard.

S. mumia.

PLATE VI.

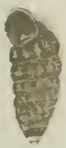


1

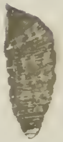


2

Strophia microstoma Pfeiffer.

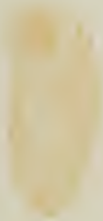


4

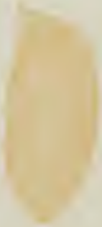


5

Strophia scalarina Pfr. et Gundl.

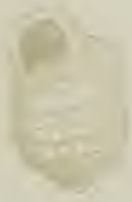


5

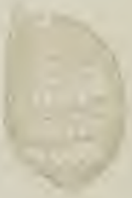


6

Strophia rudis Pfeiffer.



6

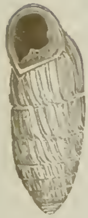


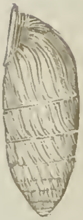
7

Strophia [illegible] [illegible]

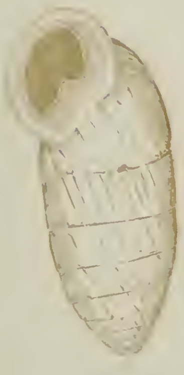
PLATE VII.

[illegible]

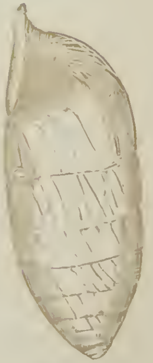




[illegible]



Strophia regia [illegible]



6